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The Addition of Enhanced Capabilities to NATO GMTIF STANAG 4607 to Support RADARSAT-2 GMTI Data

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Abstract

This Technical Memo describes the background, aims, and methodology for adding new capabilities, in the form of new extensions, to the North Atlantic Treaty Organization (NATO) Ground Moving Target Indication Format (GMTIF), known by NATO as Standardization Agreement (STANAG) 4607. These changes are required to accommodate new sensors, processing techniques, and sensor modes of operation, such as will be available from the Synthetic Aperture Radar – Ground Moving Indication (SAR-GMTI) mode onboard RADARSAT-2. Further additions are also made to provide a level of redundancy and flexibility. The RADARSAT-2 GMTI group at DRDC Ottawa was instrumental in identifying and developing these changes and having them incorporated into the GMTIF in time to support RADARSAT-2. The resulting changes, contained in Annex B, are preliminary and were needed to support data from the GMTI mode onboard RADARSAT-2. Dissemination of GMTI products is an important component of the Department of National Defence's (DND) RADARSAT-2 GMTI Technology Demonstration Project (TDP), which aims to demonstrate the utility of spaceborne GMTI measurements. RADARSAT-2 will be the first spaceborne SAR-GMTI platform to implement STANAG 4607. These advanced segment extensions will greatly enhance the dissemination capacity of GMTI data between various sensors and users. They will continue to evolve to further increase the utility and ease of use of GMTIF data to exploitation systems.

Résumé

Ce Mémoire présente la motivation, les objectifs, ainsi que la méthodologie utilisée pour l'addition de nouvelles capacités au format d'indication de cibles terrestres mobiles (GMTIF) de l'Organisation du Traité de l'Atlantique Nord (OTAN), connu par l'OTAN comme l'accord de normalisation (STANAG) 4607. L'augmentation du format est requise afin d'accommoder de nouveaux capteurs ou modes d'opération, ainsi que des nouvelles techniques de traitement de données, tels que seront disponibles en provenance du mode d'indication de cibles terrestres mobiles - Radar à Ouverture Synthétique (SAR-GMTI) à bord de RADARSAT-2. Ces changements fournissent aussi aux utilisateurs du format un niveau supérieur de redondance et de flexibilité. Le groupe du projet RADARSAT-2 GMTI à RDDC Ottawa a pris la responsabilité d'identifier et de développer les additions nécessaires aux segments de base, ainsi que d'avoir ces changements reconnus et incorporés au sein du GMTIF en temps pour être utilisés en appui de RADARSAT-2. Les modifications résultantes, énumérées dans l'Annexe B, sont préliminaires. Elles étaient requises afin d'accommoder les données en provenance du mode GMTI de RADARSAT-2. La diffusion de produits GMTI est une composante importante du Projet de Démonstration de Technologies (PDT) RADARSAT-2-GMTI du Ministère de la Défense Nationale (MND), le but de ce dernier étant de démontrer l'efficacité des mesures de cibles mobiles à partir de l'espace. Le satellite RADARSAT-2 sera la première plateforme SAR-GMTI spatiale à réaliser le format STANAG 4607. Ces augmentations aux segments de base faciliteront la dissémination de données GMTI entre différents capteurs et utilisateurs. Elles continueront à évoluer afin d'augmenter davantage l'aise de traitement de données et l'utilité de produits GMTIF aux systèmes d'exploitation de données.

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Executive summary

The Addition of Enhanced Capabilities to NATO GMTIF STANAG 4607 to Support RADARSAT-2 GMTI Data

Beaulne, P.D. DRDC Ottawa TM 2007-341; Defence R&D Canada – Ottawa; December 2007.

Introduction: STANAG 4607 is a binary, message-oriented format for the prompt dissemination of GMTI data between coalition partners. However, as it presently stands, its capacity to support SAR-GMTI data collected from a space platform such as RADARSAT-2 is limited. Supporting such data requires the addition into the GMTIF of new capabilities in the form of advanced extensions to existing GMTIF segments.

Results: The advanced segment extensions that have been developed at the behest of the DRDC-Ottawa RADARSAT-2 GMTI team fully support spaceborne SAR-GMTI sensors and provide additional sensor and target ancillary data to enhance exploitation possibilities of the GMTI data. They will play a critical role in demonstrating the use and capabilities of the RADARSAT-2 GMTI mode to the Canadian Forces (CF). The manner in which the additions have been implemented preserves the backward compatibility of this new version of STANAG 4607 with earlier ones.

Significance: Much of the information in this document was used as a baseline in the development of the advanced GMTIF extensions. The addition of support for spaceborne SAR-GMTI data provides an increased capacity to exploit such data, as well as an additional information layer, and should result in improved interoperability of joint and coalition forces using GMTI data, as has been shown in various NATO interoperability exercises using the base (airborne) version of STANAG 4607. The new capacity to support spaceborne SAR-GMTI data will offer enhanced support for the warfighter, especially in visualizing the battlefield.

Future plans: The STANAG 4607 segments and extensions described herein are being implemented by DRDC Ottawa to support GMTI data from RADARSAT-2. As implementation and testing of the extended STANAG 4607 continue, both at DRDC and elsewhere in Canada and within NATO, there will be a need to correct errors, clarify some areas and add support for further sensor capabilities. Future versions of the STANAG, for example, could contain features such as track data, MTI derived from motion imagery, and maritime mode radar. To accommodate this future growth, the GMTI Custodial Support Team, working in conjunction with the STANAG 4607 custodian, will be responsible for continued maintenance and configuration management over the lifetime of the STANAG.

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Sommaire

The Addition of Enhanced Capabilities to NATO GMTIF STANAG 4607 to Support RADARSAT-2 GMTI Data

Beaulne, P.D. DRDC Ottawa TM 2007-341; Defence R&D Canada – Ottawa; décembre 2007.

Introduction: Le STANAG 4607 est un format binaire, style-message, pour la diffusion de données GMTI entre partenaires dans une coalition. Cependant, le GMTIF tel qu'il existe présentement possède une capacité de soutien limitée pour des données SAR-GMTI en provenance d'une plateforme spatiale telle que RADARSAT-2. Le soutien de telles données nécessite l'addition au sein du GMTIF de nouvelles capacités, celles-ci prenant la forme d'augmentations avancées aux segments de base du GMTIF.

Résultats: Les augmentations avancées ont été développées suite aux interventions du groupe RADARSAT-2 GMTI de RDDC Ottawa. Elles permettent le soutien complet de capteurs SAR-GMTI spatiaux et fournissent de l'information ancillaire, ce qui permet d'augmenter les possibilités d'exploitation des données GMTI. Ces augmentations auront un rôle essentiel dans la démonstration des capacités du mode GMTI de RADARSAT-2 aux Forces Canadiennes (FC). La façon dont ces modifications ont été effectuées préserve aussi l'arrière-compatibilité de cette nouvelle version du STANAG 4607 avec les versions précédentes.

Importance: La majorité du contenu de ce document a servi comme ligne de base pour le développement des augmentations GMTIF avancées. L'addition du soutien de données SAR-GMTI spatiales fournit une capacité augmentée d'exploitation de telles données, ainsi qu'un plan d'information additionnel. Ceci devrait améliorer le niveau d'interopérabilité entre les forces dans une coalition, ce qui a été démontré dans plusieurs exercices d'interopérabilité de l'OTAN avec le format GMTIF (aérien) de base. Cette nouvelle capacité offrira aux guerriers un soutien amélioré pour la visualisation du champ de bataille.

Perspectives: Les segments (aériens) de base du STANAG 4607, ainsi que les augmentations avancées présentées dans ce mémorandum seront réalisés par RDDC Ottawa en soutien de données SAR-GMTI de RADARSAT-2. Comme la réalisation et la vérification du nouveau STANAG 4607 continuent à RDDC, au Canada et au sein de l'OTAN, il sera nécessaire de corriger des erreurs, de clarifier certains concepts et d'ajouter du soutien pour des capteurs plus avancés. Les versions futures du STANAG pourraient contenir, par exemple, un segment de poursuite de cibles, un segment de données GMTI dérivées d'imagerie vidéo ou un segment pour caractériser les cibles mobiles maritimes. Afin d'accommoder ces futures modifications, l'équipe de support technique du format 4607, en collaboration avec le gardien responsable pour le format, seront responsables pour l'entretien et pour la gestion de configuration du format pendant sa durée de vie.

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1 Introduction and Background

STANAG 4607, the NATO Ground Moving Target Indicator Format (GMTIF), is one of several Intelligence, Surveillance, and Reconnaissance (ISR) standardization agreements (STANAGs) called out under the NATO Intelligence, Surveillance, and Reconnaissance Interoperability Architecture (NIIA) [1]. This NATO effort evolved from the Common Ground Moving Data Indicator (CGMTI) Format, which had previously been developed from the ground up as a “universal” standard to meet the requirements of legacy and future U.S. radar systems for GMTI products.

The basic method for developing the STANAG was to survey applicable legacy standards (such as the NATO Exploitation Format (NATO-EX), the National Imagery Transmission Format (NITF), and others); determine which data elements (including data fields, parameters, and values) were required; and develop a clear, easy-to-implement standard based on those elements. The standard should also be capable of growth and expansion to accommodate new requirements and sensor platforms, while maintaining backward and forward compatibility between editions or versions.

The first base editions of the STANAG resulted from the ‘fusion’ of information available from various existing (airborne) GMTI sensor platforms. As such, they do not readily support the use of spaceborne platforms or multichannel Synthetic Aperture Radar (SAR) GMTI sensors, such as that carried onboard RADARSAT-2. The base editions also lack some simple ancillary information regarding properties of detected targets and their clutter environment and do not readily support sensor-centred coordinate systems for reporting target location. The addition of such quantities to the GMTIF would allow it to support GMTI data from RADARSAT-2 (or, more generally, from any space-borne platform or multichannel SAR GMTI sensor), greatly enhancing the possibilities for exploitation of the GMTI data and permitting the Canadian Forces (CF) to be interoperable in a coalition environment.

As the RADARSAT-2 GMTI Technology Demonstration Project (TDP) [2] aims to demonstrate the capabilities and the utility (including bi or multi lateral interoperability with NATO/coalition partners) of spaceborne SAR-GMTI, a suitable format for the exchange of the derived GMTI data is needed. Since STANAG 4607 is expandable, it was decided that it should be modified to support spaceborne SAR-GMTI platforms, as well as sensor coordinate and additional ancillary data reports. The DRDC RADARSAT-2 GMTI project team was the main driver pushing for these modifications, through the author of this note, who became a member of the NATO 4607 Technical Support Team responsible for changes to the GMTIF

In the first three sections, this document describes the present edition of STANAG 4607, the philosophy behind its development and use and its present shortcomings. The required additional capabilities in support of RADARSAT-2, and their rationale, are described in section 4 and the extensions themselves are described Annex B. They represent the Canadian (through DRDC Ottawa) contribution to the evolution of GMTIF STANAG 4607.

2 The Aim and Philosophy of STANAG 4607

The aim of the NATO GMTIF, STANAG 4607, is to promote interoperability for the exchange of ground moving target indicator radar data among North Atlantic Treaty Organisation (NATO) Intelligence, Surveillance, and Reconnaissance (ISR) Systems, via the prompt dissemination of MTI data. The STANAG defines a standard for the data content and format for the products of ground moving target indicator radar systems, regardless of their level of sophistication.

The GMTI Format (GMTIF) originated as an initiative to develop a common format to support the dissemination of ground MTI data from US sensor platforms [3]. It was developed by a working group originally consisting of representatives from US Government and Industry, which later grew to include Canada and the UK. Ultimately, NATO Air Group IV (AG IV) (now the Joint ISR Capabilities Group, JISRCG) recognized the need to define a standard for GMTI data and the NATO GMTI Technical Support Team (TST) was created. The GMTI TST was assigned under AG IV's Intelligence, Surveillance, and Reconnaissance Integration Working Group (ISRIWG) and, with the promulgation of the first editions of STANAG 4607, is now designated as the Custodial Support Team (CST). The CST is responsible for any additions or modifications necessary in the future evolution of the STANAG.

STANAG 4607 is primarily intended for data exchange between GMTI radar systems and their exploitation systems and to facilitate transmission, fusion, and display of that data. It provides a structured approach for various types of users (for example, low or high bandwidth) and an incremental fielding approach, depending on the user's particular data requirements. It can be used either as a standalone, embedded into other STANAGs, such as the NATO Secondary Imagery Format (NSIF, STANAG 4545) or the NATO Primary Imagery Format (STANAG 7023), used with the NATO Standard Library Interface (NSILI, STANAG 4559), or disseminated in an XML version.

The format is scalable to all levels of capability. Small-scale systems can use only those elements of the format required to transmit their data, while more robust systems can use more aspects of the format to encode all available information. For example, a user responsible for target attack would require significantly more information for a relatively small number of movers or targets, in comparison to a user who is interested only in situational awareness or knowing the general location of many potential movers.

To accomplish this scalability, the format uses two technical approaches. First, the format is divided into segments, with no predefined order or sequence other than the requirement to preface data segments with appropriate header segments, as defined in the standard. Each system using the standard is free to select the particular segments it requires for the data produced. Secondly, not all of the data fields within the segments need be sent, but may be transmitted if they are available and if they provide added value or utility and are not constrained by communications or operational considerations. With these approaches, each segment can be tailored to the data format requirements of the particular system.

Figure 1 illustrates a notional diagram for the transmission of GMTI data from the Sensor System to the Exploitation System. It shows the general relationships between Raw Data, GMTI Data, and the points at which the GMTI Format could be applied. Note that the additional processing, if required, could be accomplished on the airborne/spaceborne platform or within the corresponding ground station, depending on the system. For example, airborne platforms with exploitation capabilities can either transmit the GMTI data directly to its ground station or can exploit it directly on the platform. Note that STANAG 4607 (with the possible use of other NATO imagery STANAGS) can be used to disseminate data at any processing/exploitation stage shown in Figure 1.

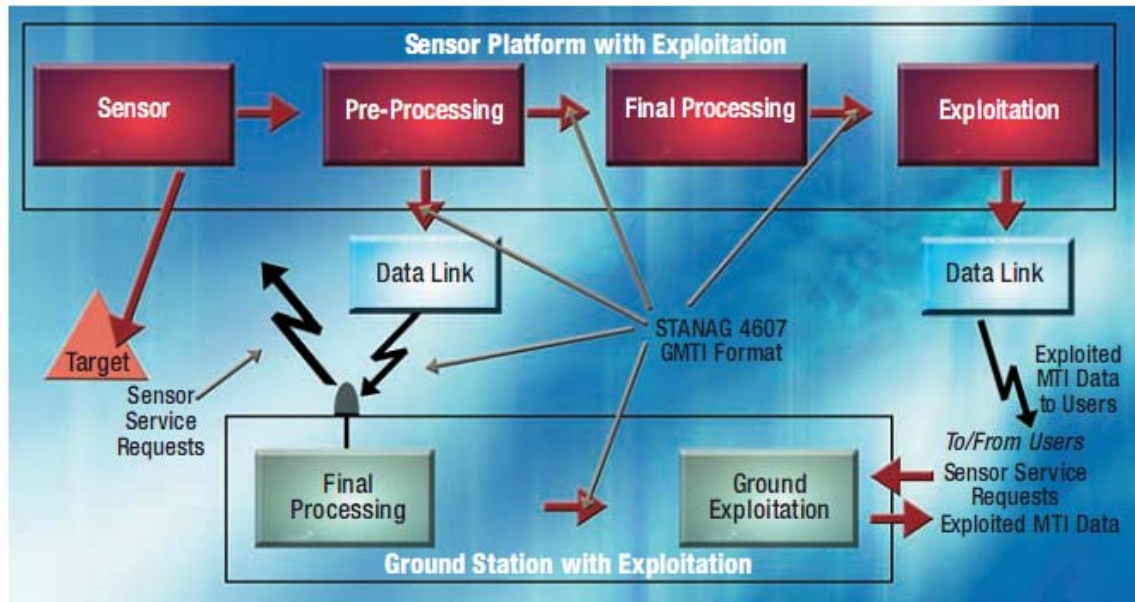


Figure 1- GMTI Data Flow Diagram (from [3])

The GMTIF format is also designed to evolve, since it includes the methodology for adding new capabilities, in the form of new extensions, to STANAG 4607. These changes will be required to accommodate new sensors, processing techniques, and sensor modes of operation. The methodology specifies that any changes to the STANAG must maintain forward and backward compatibility between editions or versions. Forward compatibility means that new systems should be designed such that they can handle earlier versions of the STANAG, while backward compatibility means that older systems should be able to handle later versions of the STANAG by ignoring certain segments or fields. This is a multi-step process, requiring proposals for new extensions from the users and approval of those extensions by the STANAG 4607 CST and Custodian before they can be added to the STANAG.

Note that the GMTI Format is not tailored to any specific communications system. Communications systems requirements must be tailored to each system on a case-by-case basis. Some key parameters to be considered are as follows:

- Robustness of the communications link (e.g., level of error protection and correction, resistance to jamming, etc.);
- Bandwidth requirements (e.g., using the GMTI Format direct, using the GMTI Format embedded in STANAG 4545 or 7023, etc.);
- Communications link restrictions (e.g., packet size limitations when using UDP, etc.);
- Link margins (e.g., transmitter power, receiver sensitivities, link losses, co-channel interference, etc.); and
- Communications latencies (e.g., processing time during transmission and reception, satellite link delays, etc.).

Note also that conformance with the NATO GMTIF does not in itself provide complete interoperability, since it defines only one presentation layer. However, STANAG 4607 does provide data that can be interpreted by any compliant ground system.

3 The Structure of STANAG 4607

The GMTIF is a binary, message-oriented format that is structured as a set of Message Segments, with each Message Segment designed to carry specific types of information. STANAG 4607 transmission is accomplished by means of packets, where each packet consists of a Packet Header and a number of Message Segments containing GMTI data pertinent to one radar job. Only those segments applicable to RADARSAT-2 SAR-GMTI data are discussed in the following.

Each segment carries a particular type of information, and any of these segments can be selected as required by mission requirements and transmitted within a packet with other segments in any desired order. If the amount of data exceeds the size limit of a GMTIF packet or if it is necessary to send the data in support of time-critical missions, the format allows a portion of the data to be sent in one GMTIF packet and the remainder of the data to be sent in subsequent GMTIF packets.

A Segment Header, which defines the type of message and the length (in bytes) of the following segment, precedes each Message Segment. Each Message Segment needed by RADARSAT-2 is defined in Annex A of this document. These include the Mission, Job Definition, Platform Location, and Dwell segments (which may include associated target reports). The present version of the full STANAG also contains other segments, which are not needed for RADARSAT-2 GMTI data. As well, placeholders exist for Range-Doppler, Group, Attached, and System-Specific Segments, but these are not implemented in the present version of the standard.

GMTIF information is transmitted in a message-oriented manner, with the message lengths defined by the Segment Headers. There is no provision or need for Start- or End-of Message characters to be transmitted. Multiple message segments of any type may be sent within the same packet. Figure 2 illustrates the general structure of the GMTIF data packet, showing representative message segments. The structure is constrained by the packet assembly rules for each segment type, as defined in Parts 2 and 3 of STANAG 4607 [4]. Note that the figure illustrates a typical GMTI packet structure and is not to be construed as representing all possible combinations of segments within a packet.

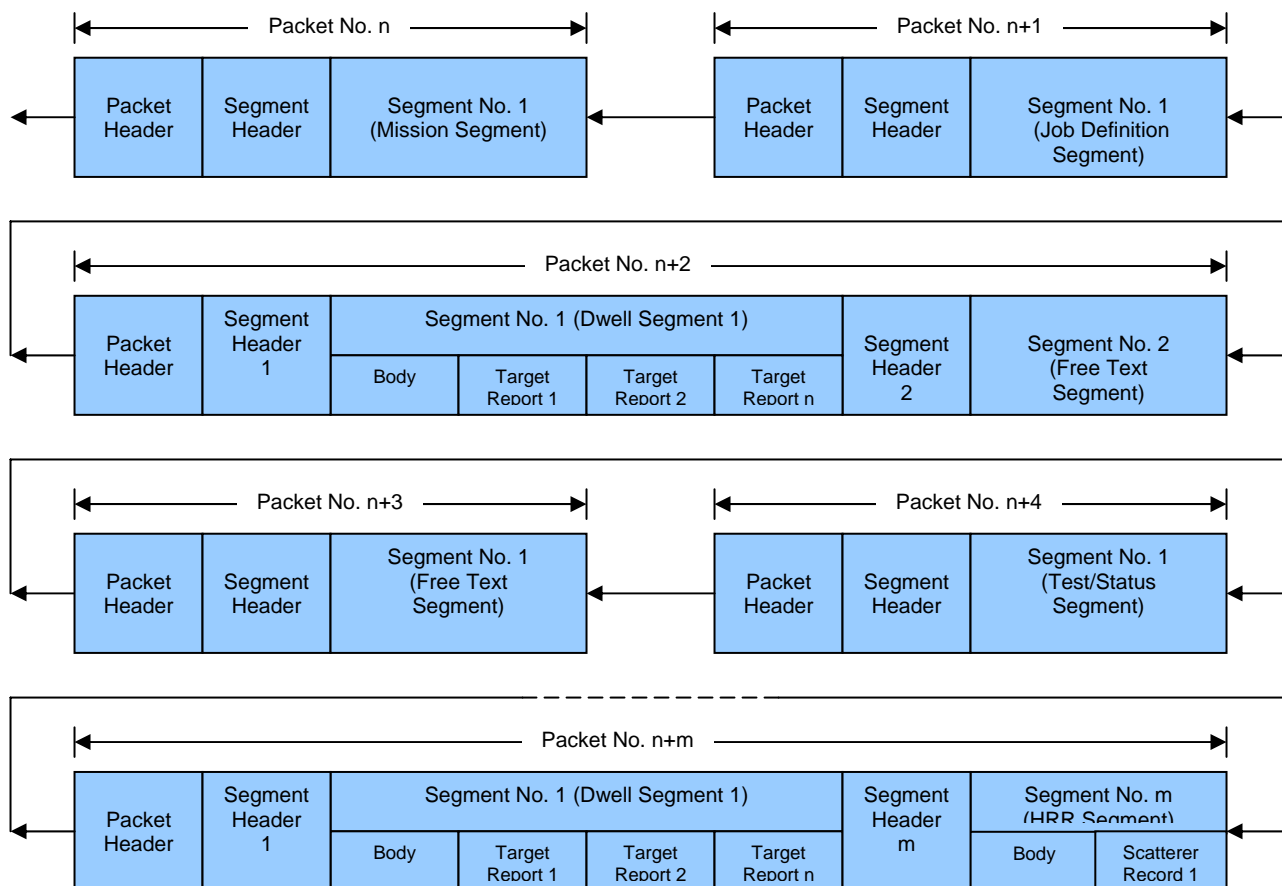


Figure 2 - Notional GMTI Format Structure (from [4])

The data format described herein allows for loss of packets but assumes that the packets received are error-free. It does not specify error detection/correction, encryption, or the physical transmission of the data. These functions must be accomplished by the lower layers of the communications media that transmit the data.

The STANAG 4607 Packet Header is sent at the beginning of each packet. It provides basic information concerning the platform, the job, the mission, nationality, security, and the length of the packet. The Segment Header is sent at the beginning of each segment transmitted within a packet and specifies the type and size of the segment that follows.

The Mission Segment provides basic information concerning the mission, including the mission plan, the flight plan, the platform type and configuration, and the reference time for the mission. Although the Mission Segment is specified to be sent at least once every two minutes, it is

preferable that it be sent more often (e.g., every thirty seconds), and preferably within each STANAG 4607 packet.

The Job Definition Segment provides information pertaining to the radar job performed by the sensor, including information pertaining to the geolocation model used in the sensor measurements.

The Platform Location Segment provides the means for the platform to transmit its location during periods when it is not collecting data, such as enroute to an orbit location or during a turn. It will not be routinely used for spaceborne platforms since their orbits are deterministic.

The Dwell Segment is sent for each dwell of the radar beam. It provides information related to dwells and revisits, the sensor location, the coverage area, the time of the dwell, sensor orientation, and sensor parameters. It includes Target Reports for any GMTI detections observed within that dwell and is sent even if no targets are detected.

A description of the above base (airborne) segments and the information they contain is reproduced in ANNEX A. However, these are not sufficient to support spaceborne SAR-GMTI data. The shortcomings of the base segments and the extensions developed to overcome them are described in the following section. More complete and detailed information on the philosophy, development, content and implementation of the base (airborne) GMTIF can be found in the full edition of the STANAG [4] and in the accompanying implementation guide [5].

4 The addition of new capabilities

As previously mentioned in Section 1, STANAG 4607 was initially developed from an overview of GMTI formats used in existing platforms. Since these platforms are airborne and carry ‘classic’ MTI sensors (which only measure target line of sight (LOS) velocity), the initial versions of STANAG 4607 cannot readily support data from either a spaceborne platform or a SAR-GMTI sensor. Therefore, extensions to the base segments were developed to enhance GMTIF capabilities. This was done in accordance with the philosophy described in section 2 (achieving forward and backward compatibility while maintaining the STANAG structure was particularly important). The structure of the data fields for the proposed new extensions conforms to the data and packet structure defined in the initial (airborne) versions of STANAG 4607 and discussed in the previous section. The proposed new extensions will be used in conjunction with the existing Packet and Segment Headers and set of Segments in that document.

The following subsections describe the present shortcomings of the STANAG, the additions necessary to support spaceborne SAR-GMTI data and the enhanced exploitation possibilities offered, as well as the rationale behind the content of the extensions. A full description of the advanced segment extensions and their content is provided in Annex B. The proposed new extensions will be used in conjunction with the existing packet and segment headers and with the set of segments listed in Annex A. These two annexes present the segments and extensions which will be supported by RADARSAT-2: they are a subset of the segments forming the full GMTIF.

4.1 SAR dwell definition and sensor-centred coordinates

Radar systems process radar transmissions and returns in time intervals. The intervals are known by various names depending on the radar specialty, e.g. dwells, arrays, scans, coherent processing intervals, etc. The dwell segment as defined in the base GMTIF does not necessarily have a one-to-one relationship to this radar dwell. The 4607 Dwell Segment allows a sensor to report on a grouping of zero or more target reports for which the sensor provides a single time, sensor position, reference position, with simple estimates for the observed area at the reported time. All of the target reports within a dwell segment are valid for the same (slow) time, which is to say the reported dwell time.

The ‘classical MTI’ concept of a dwell has it containing all targets detected in the instantaneous beam footprint. The targets appear at different ranges, but the ability to localize them in the cross range direction is limited to the size of the beam footprint on the ground. This presents problems for radar systems such as a side-looking SAR, where the radar returns are coherently processed in slow time to improve the resolution in the cross-range direction. This cross-range ‘direction’ can be the angle of arrival (AOA) of the return, for example, or, in the case of a SAR, the along-track azimuth position.

In a SAR, the azimuth position is obtained by coherent processing of a target’s radar returns over an interval known as a Coherent Processing Interval (CPI). For a SAR, the CPI is the entire time said target was within the physical beam footprint of the radar. This is also known as synthesizing an aperture, the length of which is just the extent of the along-track beam footprint width [6]. The coherent processing positions the target in azimuth at the along-track location where the target

was broadside to the sensor (neglecting beam squint). Therefore, a SAR can localize a target in the cross range (azimuth) direction to a much greater precision than the synthetic aperture (beam footprint) length.

The present GMTIF structure, where all target reports within a dwell segment are referenced to the same time, complicates the reporting of SAR-GMTI target positions. One solution is to define a single dwell segment for each target, but this would involve a significant amount of information duplication.

The solution chosen for reporting RADARSAT-2 SAR-GMTI data is to define a 'dwell' as a subset of the coherently processed SAR image and 'pretend' that all targets detected within that image subset were observed at the dwell time reported in the dwell segment. This is shown conceptually in Figure 3. Radar returns are coherently processed over CPI's to compress targets in azimuth. Azimuth subsets (groups of CPI's) are assembled into dwells. Revisits are not applicable to RADARSAT-2.

The azimuth partitioning of the processed SAR image is done on the basis of detected targets. A dwell segment can contain at most 65535 target reports, so dwell segments are limited to processed azimuth subsets of less than this number. However, the proper reporting of along track target positions within the dwell requires modification of the base (airborne) target reports.

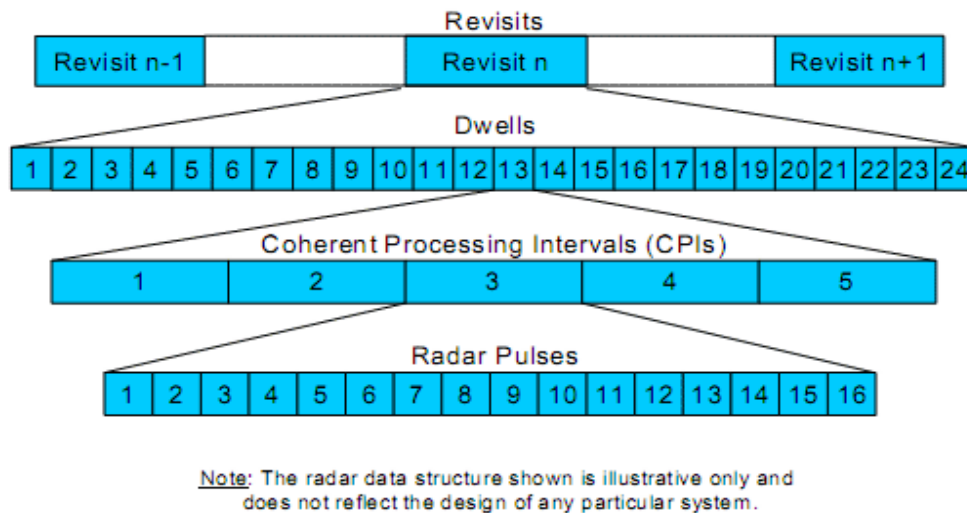


Figure 3 – Notional Radar Dwell Structure (from [4])

It was therefore decided that the target report extensions should provide a field to specify a target's cross range position (in linear or angular units, depending on the type of MTI radar). This modification also overcomes another deficiency in the base STANAG. The granularity of the dwell time field is insufficient to accommodate a SAR operating at a pulse repetition frequency (PRF) greater than 1 kHz.

The cross-range position in the target report extension is specified in sensor centred coordinates using angles from the sensor to the target, or in the case of SAR, an along track azimuth position. The azimuth position is reported not as a linear distance, but as a slow time (the pulse transmission time). This slow time is referenced to the dwell time, has a granularity of 10 nanoseconds and can be positive or negative (since the dwell time is at the centre of the dwell). The absolute time at which the target is detected (dwell time + target slow time) specifies where on orbit the platform was located when it was broadside to the target. This absolute time, along with the platform velocity provided in the dwell segment, allow for the calculation of an azimuth distance. See section B.1 of Annex B for more details on the target azimuth slow time, as well as on the angular cross-range specifications.

The addition of a sensor-centred cross range measurement to the target report extension allows greater flexibility in the definition of dwell segments. However, the slow time does not completely specify the target position in sensor space. This also requires the slant range from sensor to target at the reported (azimuth) slow time. Hence, the measured target slant-range was also included in the target report extension (see section B.1 in Annex B) in order to provide the maximum utility and flexibility in reporting target coordinates.

The addition of sensor-centred target coordinate reports, in addition to providing more flexibility for platforms (targets can be reported in geographic coordinates, sensor coordinates, or both), greatly enhances the exploitation possibilities of the data. Knowledge of platform position or antenna pointing, along with the sensor measurements and an earth model, permit the target's geographic coordinates to be calculated [7]. This geolocation process can offer enhanced exploitation properties.

In the base GMTIF, exploitation stations must rely on the target geographic coordinates as provided by the platform or its ground station, since sensor coordinates are not available. Information provided on the platform position and orientation is useful for creating area masks and the like, but provides little additional exploitation capacity. However, when combined with sensor-centred target measurements, the enhanced (see section 4.2) platform information can be used to perform target geolocation. This enables an exploitation to recalculate a more accurate geographic target positions based on better maps, elevation or geoid models or the area than may be available to the sensors of their groundstations.

Note that reporting sensor-centred coordinates provides some redundancy, which can be useful in the event of packet loss. It also allows the GMTIF to be used by a wider range of GMTI sensors. Sensors or groundstations with limited or no exploitation capability can simply report their measurements and leave the geolocation to be performed further down the chain. An exploitation station may also want to recalculate the positions of targets from various sensor platforms according to its own algorithms to ensure consistency of target reports in a Common Operating Picture (COP).

4.2 Coordinate systems for spaceborne platforms

In the base GMTIF, sensor and (airborne) platform positions are measured in a geodetic system: by longitude in degrees from the Greenwich Meridian (positive East); by geodetic latitude as the

planar angle formed between the perpendicular to the reference ellipsoid for the specified earth model (the World Geodetic System of 1984 (WGS-84) and the equatorial plane (positive North); and by height in metres either from the reference ellipsoid (or from mean sea level if a geoid model is being used) to the point of interest.

This specification works well for airborne platforms but not for spaceborne ones. Orbiting platform position coordinates are naturally expressed, to a high degree of accuracy, in an Earth-Centred Cartesian coordinate system, where the z -axis is the earth polar axis and the xy plane is the equatorial plane [7]. Such a Cartesian position can be transformed to a geodetic system. However, the cost is a loss in the accuracy of the position specification and its dependence on the particular ellipsoid and/or geoid models used in the transformation. In addition, the geodetic height field in the base GMTIF Dwell segment is too small to report the full range of possible satellite altitudes. It was therefore decided that the advanced dwell segment extension should contain fields specifying the satellite position to the nearest millimetre in an Earth-centred Cartesian system. More details on these additions can be found in sections B.1 and B.3 of Annex B.

The base GMTIF also defines a platform orientation system at the platform location. The platform orientation is expressed in terms of Heading from true north (or Yaw), Pitch, and Roll as a series of rotations about the Yaw Axis, Pitch Axis, and Roll Axis, respectively, as shown in Figure A.5.1. Section A.5 of Annex A more fully describes the orientation specification for an airborne platform.

Again this attitude specification is sufficient to describe the orientation of an airborne platform, but fails for one in space. A satellite on orbit follows a specified path in inertial space, but the projection of its track onto the ground follows a more complicated path due to the rotation of the earth beneath the satellite. As such, the ground track heading from true north is constantly changing.

It was therefore decided that the advanced dwell extension should support the specification of platform attitude in a standard spacecraft-centred coordinate system [8] where the yaw axis is along the radial position vector from earth centre to the platform, the pitch axis is along the angular momentum vector (i.e. normal to the plane formed by the platform position and velocity vectors) and the roll axis completes a right-handed triad. This is illustrated in Figure 4.

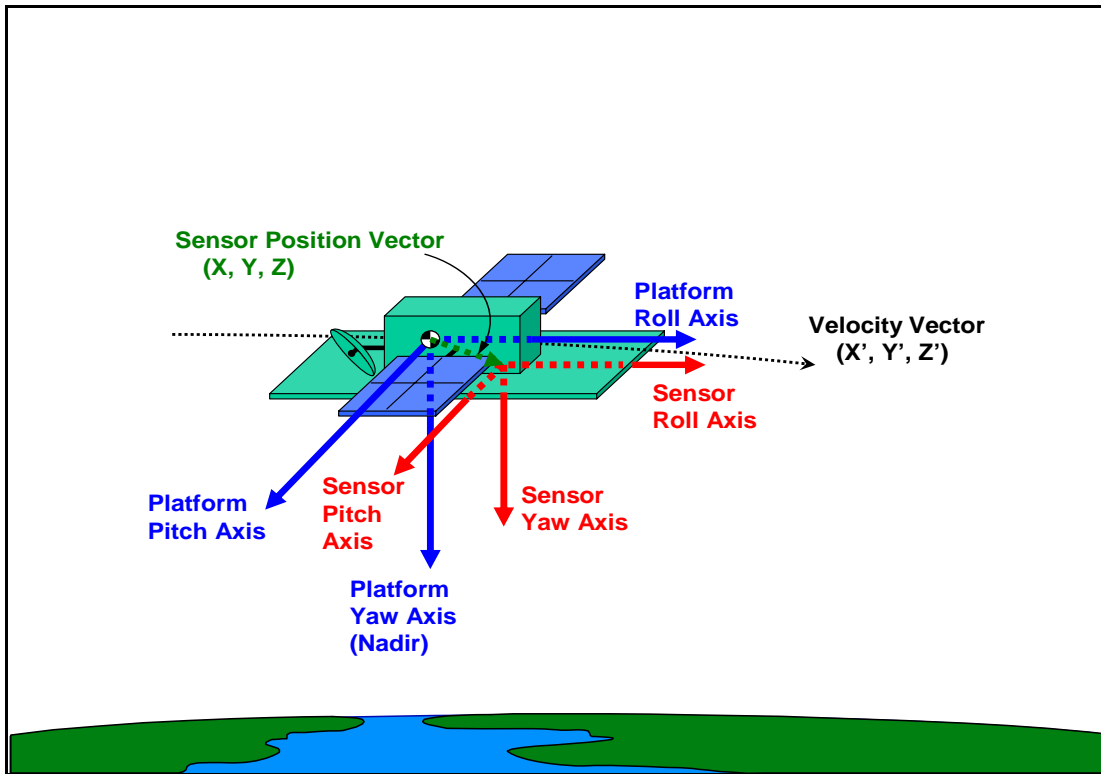


Figure 4 - Illustration of attitude specification axes for a spaceborne platform. The green position vector relates the platform and sensor positions. (from [4]).

The relationship between the Platform Position and the sensor position is expressed as the Sensor Position Vector. This is a vector (shown in green in Figure 4) which defines an offset from the Platform centre of gravity to the phase centre of the sensor. In the case of an Electronically Steerable Antenna (ESA), the Sensor Position Vector can refer to any phase centre on the antenna, and can vary from dwell to dwell. It was decided that the specification of this offset was necessary for applications requiring a high degree of precision.

The addition of these coordinate systems in the advanced extensions to the GMTIF allows for the complete specification of platform and sensor positions, as well as antenna pointing information, to as high a degree of accuracy as can be provided by the platform in question.

4.3 Additional target characterization and error estimates

This section discusses additional data related to target, sensor and data processing properties. Most of the quantities listed below are optional and need only be transmitted if platforms can or wish to provide the data. It was decided that these quantities should be added to the base GMTIF in order to fully support spaceborne SAR-GMTI sensors and to provide additional sensor and target ancillary data, as well as error estimates, to enhance exploitation possibilities. A short explanation of the additional data quantities is provided below.

- **Target velocity:** The base (airborne) GMTIF provides a single field to report the target radial (line of sight) velocity. However, certain MTI sensors can measure more than the radial velocity. RADARSAT-2 will be able to measure radial velocity, but will also be able to resolve two velocity components for ground moving targets; one in the along track (azimuth) direction and the other in the cross-track (ground range) direction. These components can also be expressed as a target speed and heading. The addition of these quantities to the extended target reports (see section B.1 of Annex B) allows more accurate reporting of the target velocity vector in the format (2 components or speed and heading) most appropriate to the platform in question.
- **Target incidence angle and radar cross section (RCS):** The base GMTIF target report contains fields for target classification and its probability. However, a sensor or its groundstation may not have access to enough information to appropriately classify a target type. Hence the addition of additional target properties like the incidence angle at the target and its radar cross section to the target report extension provides additional information that can be used by an exploitation station to either classify an unknown target, or to update a previous classification provided in the base target report.
- **Radar and processing parameters:** In order to allow exploitation stations to perform more detailed analyses of targets and their properties, it was decided that additional information was required about certain parameters of both the radar system and the processing involved in extracting target information.

The radar parameters added to the advanced job definition extension are the carrier frequency and the 3dB beamwidths in both azimuth and elevation, which are needed in a number of calculations that might be performed by an exploitation system.

A number of useful processing parameters are also included in the advanced segment extensions. These include slant range resolution (impulse response width) and pixel spacing, cross-range resolution and pixel spacing, the range aliasing distance (wrap range), the minimum range of the dwell and the terrain elevation at the centre of the dwell. These allow an exploitation station to perform any calculations necessary. They also provide a level of redundancy; that is, certain data elements can be used to cross check other elements and ensure internal consistency of the data.

- **Error estimates:** Certain quantities in the base GMTIF are accompanied by estimates of the error in that quantity, while others have no associated error. It was decided that it would be useful to include error estimates not only for quantities added to the advanced extensions, but also for quantities in the base GMTIF for which no error estimates were previously provided. The addition of error estimates for all reported quantities should provide powerful tools to assist in data-based decision making.

5 Conclusion

This document has described the development of the GMTIF STANAG 4607 and the philosophy behind it. Shortcomings of the existing (airborne) GMTIF versions, such as insufficient support for spaceborne SAR-GMTI platforms and limited exploitation capacity, have been identified. The addition of advanced segment extensions to overcome these deficiencies (and more specifically, to support RADARSAT-2 GMTI data) has been described in detail. This description has included the specification of the advanced segment extensions and the justification for the quantities contained therein. More specifically, the segments and extensions being implemented by the RADARSAT-2 GMTI team at DRDC Ottawa (and which form the bulk of the needed changes incorporated by NATO into the GMTIF) are presented.

The addition of these new capabilities to the GMTIF will provide an increased capacity to exploit GMTI data from numerous sensors on differing platforms. The utility of the base (airborne) GMTIF, despite its shortcomings, has been shown in various NATO aerial interoperability exercises, such as those conducted under the Coalition Aerial Surveillance and Reconnaissance (CAESAR) & Multi-sensor Aerospace-Ground Joint ISR Interoperability Coalition (MAJIC) projects [9,10]. The addition of support for spaceborne SAR-GMTI data is expected to further enhance the utility of GMTIF data, as the DRDC RADARSAT-2 GMTI group aims to demonstrate to the CF in upcoming trials, once the satellite is launched.

Overall, the enhanced capabilities described in this document were driven by the needs of the DRDC RADARSAT-2 GMTI project. In addition to providing support for RADARSAT-2 GMTI data in the GMTIF, they will result in improved interoperability of joint and coalition forces using GMTI data. They will also provide increased support for the warfighter, especially in visualizing the exploited GMTI data used in support of a common operational picture of the battlefield.

Annex A Edition 2 of the base GMTIF STANAG 4607

This section provides tables and descriptions of the GMTIF Packet and Segment Headers and the Mission, Dwell, Job Definition, and Platform Location Segments. The headers and segments described in this Annex are required for, and form the base of, the GMTI Format. The advanced extensions added to these segments to support RADATSAT-2 GMTI data are listed in Annex B. Additional segments from the base GMTIF, which are not used by RADARSAT-2, are not shown. In the following tables, entries in blue indicate quantities which will always be reported by RADARSAT-2 GMTI, those in green indicate quantities which can be provided depending on the users' needs and bandwidth considerations, while those in red will not be implemented by RADARSAT-2 GMTI.

A.1 Packet Header

The Packet Header (Table A-1) shall be sent at the beginning of each packet. It identifies the format version of the data contained in the packet, the size of the packet, and information pertaining to the platform, security, and the mission.

Table A-1. Packet Header

Field	Type	Field Name		Bytes	Form	Value
P1	M	4607 Version ID		2	A	
P2	M	Packet Size		4	I32	32 to 4294967295
P3	M	Nationality		2	A	CA (Table A-3)
P4	M	Packet	Classification	1	E8	Table A-2
P5	M	Security	Class. System	2	A	CA (Table A-3)
P6	M	Data	Code	2	FL	Table A-4
P7	M	Exercise Indicator		1	E8	RADARSAT-2
P8	M	Platform ID		10	A	Sec A.1.8 (TBD)
P9	M	Mission ID		4	I32	Sec A.1.9 (TBD)
P10	M	Job ID		4	I32	0, 1 to 4294967295

A.1.1 Version ID (P1) (M).

A two-character alphanumeric code indicating the version of STANAG 4607 to which the packet conforms.

It shall be of the form “mn”, where “m” indicates the edition number and “n” indicates the amendment number of that edition. For example, a value of “10” indicates that it is edition 1 without any amendments. A value of “11” indicates that it is the edition 1 with amendment number 1 incorporated.

A.1.2 Packet Size (P2) (M).

The number of bytes in the entire packet, including this header.

The minimum packet size shall be the number of bytes in the Packet Header, as shown in Table A-1.

A.1.3 Nationality (P3) (M).

A digraph, in accordance with the Federal Information Processing Standards (FIPS) Publication 10-4: “Countries, Dependencies, Areas of Special Sovereignty, and Their Principal Administrative Divisions”, that identifies the nationality of the platform providing GMTI data.

The Country Codes are listed in Table A-3. NATO platforms providing GMTI data shall use the digraph XN.

A.1.4 Packet Security – Classification (P4) (M).

An enumeration table indicating the classification level of the packet.

Allowable values are shown in Table A-2.

Table A-2. Packet Security Classification

VALUE	CLASSIFICATION
1	TOP SECRET
2	SECRET
3	CONFIDENTIAL
4	RESTRICTED
5	UNCLASSIFIED
6	NO CLASSIFICATION

A.1.5 Packet Security – Classification System (P5) (M).

A digraph indicating the national or multinational security system to which the security classification in field P4 conforms. Country codes for national security systems are in accordance with FIPS Publication 10-4.

Example values are shown in Table A-3. If this field is all BCS spaces (hexadecimal 0x20), it indicates that no Security Classification System applies to the file.

Table A-3. Packet Classification Systems

CLASSIFICATION SYSTEM	DIGRAPH
Country Codes defined in FIPS Publication 10-4	BE, CA, DA, FR, GM, GR, IS, IT, LU, NL, NO, PO, SP, TR, GB, US
NATO Security System	XN
Additional codes	As registered with the Custodian

A.1.6 Packet Security – Code (P6) (M).

A two-byte flag field, defined in Table A-4, which indicates additional control and/or handling instructions associated with the GMTI data.

A value of 0 (hex 0x00) indicates there are no additional security codes that apply to the GMTI data. Each bit of the field, when set to a binary “1”, indicates that the corresponding security code in Table A-4 applies to the data. This field allows multiple security codes to be associated with the GMTI data. (NOTE: This table is representative, based on US security handling codes, and is not an exhaustive list of all allowable codes. Each nation shall be responsible for developing and publishing their own packet security handling codes as required.

Table A-4. Packet Security Codes

VALUE (HEX)	CODEWORD
0x0000	NONE (NO-STATEMENT VALUE)
0x0001	NOCONTRACT
0x0002	ORCON
0x0004	PROPIN
0x0008	WNINTEL
0x0010	NATIONAL ONLY
0x0020	LIMDIS
0x0040	FOUO
0x0080	EFTO
0x0100	LIM OFF USE (UNCLAS)
0x0200	NONCOMPARTMENT
0x0400	SPECIAL CONTROL
0x0800	SPECIAL INTEL
0x1000	WARNING NOTICE – SECURITY CLASSIFICATION IS BASED ON THE FACT OF EXISTENCE AND AVAIL OF THIS DATA
0x2000	REL NATO (BEL, BGR, CAN, CZE, DNK, EST, FRA, DEU, GRC, HUN, ISL, ITA, LVA, LTU, LUX, NLD, NOR, POL, PRT, ROU, SVK, SVN, ESP, TUR, GBR, USA)
0x4000	REL 4-EYES (AUS, CAN, GBR, USA)
0x8000	REL 9-EYES (CAN, FRA, DEU, NLD, NOR, ESP, TUR, GBR, USA)

A.1.7 Exercise Indicator (P7) (M).

An enumeration table indicating whether the data contained in this packet is from a real-world military operation or from an exercise, and whether the data is real (originates from live-fly or other non-simulated operational sources), simulated (originates from target simulator sources), or synthesized (a mix of real and simulated data).

Allowable values are shown in Table A-5.

Table A-5. Exercise Indicator

VALUE	DEFINITION
0	Operation, Real Data
1	Operation, Simulated Data
2	Operation, Synthesized Data
3-127	Reserved
128	Exercise, Real Data
129	Exercise, Simulated Data
130	Exercise, Synthesized Data
131-255	Reserved

A.1.8 Platform ID (P8) (M).

An alphanumeric field that identifies the platform.

For aircraft the platform ID shall be the tail number. For a space-based platform the platform ID shall be the satellite name with an appropriate numerical designator. For other systems, an appropriate unique designator shall be used. Unused bytes shall be filled with the BCS space character (hex 0x20). In all cases, the platform ID is determined by the nation owning the platform, whose responsibility it is to ensure that all its platforms are uniquely identified within the set of platforms it owns.

A.1.9 Mission ID (P9) (M).

An integer field, assigned by the platform identified in Field P8, which uniquely identifies the mission for the platform.

A.1.10 Job ID (P10) (M).

A platform-assigned number identifying the specific request or task to which the packet pertains.

The Job ID shall be unique within a mission. A Job ID of 0 (hex 0x00) indicates there is no reference to any specific request or task. If the Job ID in the Packet Header is 0 (hex 0x00), then the packet can not contain Dwell, HRR, or Range-Doppler segments.

A.2 Segment Header

The Segment Header (Table A-6) shall be sent at the beginning of each segment transmitted within a packet. It identifies the type and size of the segment that follows.

Table A-6. Segment Header

Field	Type	Field Name	Bytes	Form	Value
S1	M	Segment type	1	E8	1= Mission Segment 2= Dwell Segment 3=HRR Segment 4=Range-Doppler Segment 5= Job Definition Segment 6= Free text Segment 7=Low Reflectivity Index Segment 8=Group Segment 9=Attached Target Segment 10=Test and Status Segment 11=System Specific Segment 12=Processing History Segment 13=Platform Location Segment 14-100=Reserved for new segments 101=Job Acknowledge Segment 102=Job Request Segment 103-127=Reserved for future use 128-255=Reserved for extensions
S2	M	Segment size	4	I32	

NOTE: Refer to the Registry of Controlled Extensions in the NATO Ground Moving Target Indicator (GMTI) Format Implementation Guide, AEDP-7 [5], for additional segments which have been approved for use with STANAG 4607.

A.2.1 Segment Type (S1) (M).

An enumeration table indicating the type and content of the data segment which follows this header.

The enumeration table for Segment types is shown in Table A-6. Data segments corresponding to the values 4, 7, 8, 9, 11, 14-100, and 103-255 are reserved for future use.

A.2.2 Segment Size (S2) (M).

Number of bytes in this header and the data segment which follows this header.

It is not to exceed the maximum packet size as designated in field P2, Packet Size, of the Packet Header, minus the size of the Packet Header itself.

A.3 Mission Segment

The Mission Segment (Table A-7) provides information concerning the mission and shall be sent periodically at least once every two minutes. It includes information on the mission and flight plans, the type and configuration of the platform, and the reference time. Note that the Dwell Time (field D6) specified in any associated Dwell Segments is referenced to the Reference Time (fields M5-M7) in the Mission Segment, and will not be resolved as to the day of the mission until the Mission Segment is received from the transmitting platform.

Table A-7. Mission Segment

Field	Type	Field Name		Bytes	Form	Value
M1	M	Mission Plan		12	A	Sec. A.3.1 (TBD)
M2	M	Flight Plan		12	A	Sec. A.3.2 (TBD)
M3		Platform Type		1	E8	Table A-8 (10)
M4	M	Platform Configuration		10	A	Sec. A.3.4 (TBD)
M5	M	Reference Time	Year	2	I16	eg. 2007
M6	M		Month	1	I8	1 to 12
M7	M		Day	1	I8	1 to 31

A.3.1 Mission Plan (M1) (M).

An alphanumeric field that identifies the mission, and which shall be unique for all the missions defined for that platform.

For aircraft or land-based systems, the Mission Number from the Air Tasking Order (ATO) or an equivalent document shall be used. For space-based platforms, the mission identifier or a suitable designator such as “yymmhhnn”, where yy (year), mm (month), and hh (hour) indicate the time the collection mission began and nn is the identifying number of the satellite, shall be used. If there is no Mission Plan to be sent, or if there are unused bytes in the field, the field shall be filled with the BCS space character (hex 0x20).

A.3.2 Flight Plan (M2) (M).

An alphanumeric field that identifies the flight plan.

This field provides a unique identification of the flight plan. If the flight plan is not available from the ATO or an equivalent source, a suitable unique identifier may be inserted in this field. If there is no Flight Plan to be sent, or if there are unused bytes in the field, the field shall be filled with the BCS space character (hex 0x20).

A.3.3 Platform Type (M3) (M).

An enumeration table that identifies the type of platform that originated the data (Table A-8).

Table A-8. Platform Types

PLATFORM	VALUE
Unidentified	0
ACS	1
ARL-M	2
Sentinel (<i>was ASTOR</i>)	3
Rotary Wing Radar (<i>was CRESO</i>)	4
Global Hawk-Navy	5
HORIZON	6
E-8 (Joint STARS)	7
P-3C	8
Predator	9
RADARSAT2	10
U-2	11
E-10 (<i>was MC2A</i>)	12
UGS - Single	13
UGS - Cluster	14
Ground Based	15
UAV-Army	16
UAV-Marines	17
UAV-Navy	18
UAV-Air Force	19
Global Hawk- Air Force	20
Global Hawk-Australia	21
Global Hawk-Germany	22
Paul Revere	23
Mariner UAV	24
BAC-111	25
Coyote	26
King Air	27
LIMIT	28
NRL NP-3B	29
SOSTAR-X	30
WatchKeeper	31
Alliance Ground Surveillance (AGS) (A321)	32
Stryker	33
AGS (HALE UAV)	34
SIDM	35
Reaper	36
Warrior A	37
Warrior	38
Available for Future Use	39-254
Other	255

A.3.4 Platform Configuration (M4) (M).

An alphanumeric field indicating the particular variant of the platform.

It identifies sensor complements, upgrades, or other identifying information. Examples would be a model number, software release number, clarifications of differences in platform types, or identification of the platform as a test article. A recommended default value is an identification of the software and/or hardware version. If there is no Platform Configuration to be sent, the fields shall be filled with the BCS space character (hex 0x20).

A.3.5 Reference Time – Year (M5) (M).

The year in which the mission originated.

For airborne platforms, this shall be the takeoff time. For spaceborne platforms, this shall be an epoch time, which shall be selected suitable for the collection. For ground-based platforms, a time reference suitable for collection shall be selected.

A.3.6 Reference Time – Month (M6) (M).

The month of the year in which the mission originated. For airborne platforms, this shall be the takeoff time. For spaceborne platforms, this shall be an epoch time, which shall be selected suitable for the collection. For ground-based platforms, a time reference suitable for collection shall be selected.

A.3.7 Reference Time – Day (M7) (M).

The day of the month in which the mission originated.

For airborne platforms, this shall be the day of takeoff. For satellite platforms, this shall be an epoch time, which shall be selected suitable for the collection. For ground-based platforms, a time reference suitable for collection shall be selected.

Note that the Dwell Time fields, D6 in the Dwell Segment and T4 in the Test and Status Segment, are obtained as the count in milliseconds from the time 00:00:00 UTC of this day. The maximum value of field D6 is equivalent to 49 days. Therefore, to prevent the time stamp in field D6 from being repeated, a new mission day must be provided every 49 days or more frequently.

A.4 Job Definition Segment

The Job Definition Segment (Table A-9) provides the means for the platform to pass information pertaining to the sensor job that will be performed and details of the location parameters (terrain elevation model and geoid model) used in the measurement. It includes a definition of the geographic area for sensor service, the Bounding Area, which is defined as a four-corner polygon, with the four points of the polygon chosen to define a convex quadrilateral.

The Bounding Area shall remain fixed for a given Job ID. The Job Definition Segment shall be sent before the first revisit of a job and shall be sent periodically at least once every 30 seconds thereafter. Note that precision location of a target will not be possible until the information contained in the Job Definition segment has been received from the transmitting platform.

Table A-9. Job Definition Segment

Field	Type	Field Name		Bytes	Form	Value	Units
J1	M	Job ID		4	I32	1 to 4294967295	bytes
J2	M	Sensor ID	Type	1	E8	Table A-10 (10)	
J3	M		Model	6	A	Sec A.4.3 (GMTI)	
J4	M	Target Filter Flag		1	FL8	Sec A.4.4 (0)	
J5	M	Priority (radar priority)		1	I8	Sec A.4.5 (1)	
J6	M	Bounding Area	A Lat	4	SA32	- 90 to +89.999989	degrees
J7	M		A Long	4	BA32	0 to +359.999979	degrees
J8	M		B Lat	4	SA32	- 90 to +89.999989	degrees
J9	M		B Long	4	BA32	0 to +359.999979	degrees
J10	M		C Lat	4	SA32	- 90 to +89.999989	degrees
J11	M		C Long	4	BA32	0 to +359.999979	degrees
J12	M		D Lat	4	SA32	- 90 to +89.999989	degrees
J13	M		D Long	4	BA32	0 to +359.999979	degrees
J14	M	Radar Mode		1	E8	Table A-11 (1)	
J15	M	Revisit interval		2	I16	0,1 to 65535	deciseconds
J16	M	Nominal Sensor	Along track	2	I16	0 to 10000	decimetres
J17	M	Position	Cross track	2	I16	0 to 10000	decimetres
J18	M	Uncertainty	Altitude	2	I16	0 to 45	degrees
J19	M	y	Track Heading	1	I8	0 to 65534	millimetres/sec
J20	M		Sensor speed	2	I16		
J21	M	Nominal Sensor Value	Slant Range SD	2	I16	0 to 65534	centimetres
J22	M		Cross Range SD	2	BA16	0 to 179.9945	degrees
J23	M		Radial Vel. SD	2	B16	0 to 5000	centimetres/sec
J24	M		MDV	1	I8	0 to 254	
J25	M		P _D	1	I8	0 to 100	percent
J26	M		P _{FA}	1	I8	0 to 254	Negative dB
J27	M	Terrain Elevation Model		1	E8	Table A-12	
J28	M	Geoid Model		1	E8	Table A-13	

A.4.1 Job ID (J1) (M).

A platform assigned number identifying the specific request or task to which the dwell pertains.

A.4.2 Sensor ID – Type (J2) (M).

An enumeration table denoting the type of sensor or the platform.

Current sensor types are listed in Table A-10. A Sensor ID - Type value of “255” indicates that it is a No Statement and no sensor type is specified. New sensor types shall be registered with the Custodian.

Table A-10. Sensor Types

SENSOR	VALUE
Unidentified	0
Other	1
HiSAR	2
ASTOR	3
Rotary Wing Radar (<i>was CRESO</i>)	4
Global Hawk Sensor	5
HORIZON	6
APY-3	7
APY-6	8
APY-8 (Lynx I)	9
RADARSAT2	10
ASARS-2A	11
TESAR	12
MP-RTIP	13
APG-77	14
APG-79	15
APG-81	16
APY-6v1	17
DPY-1 (Lynx II)	18
SIDM	19
LIMIT	20
TCAR (AGS A321)	21
LSRS Sensor	22
UGS Single Sensor	23
UGS Cluster Sensor	24
Available for Future Use	25-254
No Statement	255

A.4.3 Sensor ID – Model (J3) (M).

An Alphanumeric field identifying the particular variant of the sensor type.

A.4.4 Target Filtering Flag (J4) (M).

A flag field indicating whether or not filtering has been applied to the targets detected within the dwell area and the type of filtering, if any, that has been applied.

A Target Filtering Flag of zero (hex 0x00) indicates that no filtering has been applied to the targets.

If bit 0, the least significant bit, is set to a binary “one”, this indicates that area filtering within the intersection of the Dwell Area and the Bounding Area has been performed.

If bit 1 is set to a binary “one”, this indicates that Area blanking has been applied. However, the format does not currently specify the sector over which blanking has been applied.

If bit 2 is set to a binary “one”, this indicates that Sector Blanking has been applied. However, the format does not currently specify the sector over which blanking has been applied.

Bits number 3-7 shall be reserved for future growth.

A.4.5 Priority (Radar Priority) (J5) (M).

Specifies the priority of this tasking request relative to all other active tasking requests scheduled for execution on the specified platform.

A value of 255 indicates the Job is ended.

A.4.6 Bounding Area – Point A Latitude (J6) M.

The North-South position of the first corner (Point A) defining the area for sensor service, expressed as degrees North (positive) or South (negative) of the Equator.

The four corners (J6 through J13) of the bounding area, expressed as lat/long for each corner, are given in clockwise order (Points A, B, C, and D) and must form a convex quadrilateral.

A.4.7 Bounding Area – Point A Longitude (J7) M.

The East-West position of the first corner (Point A) defining the area for sensor service, expressed as degrees East (positive) of the Prime Meridian.

The four corners (J6 through J13) of the bounding area, expressed as lat/long for each corner, are given in clockwise order (Points A, B, C, and D) and must form a convex quadrilateral.

A.4.8 Bounding Area – Point B Latitude (J8) M.

The North-South position of the second corner (Point B) defining the area for sensor service, expressed as degrees North (positive) or South (negative) of the Equator.

The four corners (J6 through J13) of the bounding area, expressed as lat/long for each corner, are given in clockwise order (Points A, B, C, and D) and must form a convex quadrilateral.

A.4.9 Bounding Area – Point B Longitude (J9) M.

The East-West position of the second corner (Point B) defining the area for sensor service, expressed as degrees East (positive) of the Prime Meridian.

The four corners (J6 through J13) of the bounding area, expressed as lat/long for each corner, are given in clockwise order (Points A, B, C, and D) and must form a convex quadrilateral.

A.4.10 Bounding Area – Point C Latitude (J10) M.

The North-South position of the third corner (Point C) defining the area for sensor service, expressed as degrees North (positive) or South (negative) of the Equator.

The four corners (J6 through J13) of the bounding area, expressed as lat/long for each corner, are given in clockwise order (Points A, B, C, and D) and must form a convex quadrilateral.

A.4.11 Bounding Area – Point C Longitude (J11) M.

The East-West position of the third corner (Point C) defining the area for sensor service, expressed as degrees East (positive) of the Prime Meridian.

The four corners (J6 through J13) of the bounding area, expressed as lat/long for each corner, are given in clockwise order (Points A, B, C, and D) and must form a convex quadrilateral.

A.4.12 Bounding Area – Point D Latitude (J12) M.

The North-South position of the fourth corner (Point D) defining the area for sensor service, expressed as degrees North (positive) or South (negative) of the Equator.

The four corners (J6 through J13) of the bounding area, expressed as lat/long for each corner, are given in clockwise order (Points A, B, C, and D) and must form a convex quadrilateral.

A.4.13 Bounding Area – Point D Longitude (J13) M.

The East-West position of the fourth corner (Point D) defining the area for sensor service, expressed as degrees East (positive) of the Prime Meridian.

The four corners (J6 through J13) of the bounding area, expressed as lat/long for each corner, are given in clockwise order (Points A, B, C, and D) and must form a convex quadrilateral.

A.4.14 Radar Mode (J14) (M).

An enumeration table that identifies the mode in which the radar will operate for a given job ID.

Radar operating modes are system specific and shall be determined for each system. Table A-11 provides a list of system specific radar operating modes.

Table A-11. Radar Modes

RADAR MODE	SYSTEM	VALUE	RADAR MODE	SYSTEM	VALUE
Unspecified Mode	Generic	0	EMTI Augmented Spot	ASARS-2	54
MTI (Moving target Indicator)	Generic	1	EMTI Wide Area MTI (WAMTI)	ASARS-2	55
HRR (High Range Resolution)	Generic	2	Available for Future Use	Reserved	56-60
UHRR (Ultra High Range Resolution)	Generic	3	GMTI PPI Mode	TUAV	61
HUR (High Update Rate)	Generic	4	GMTI Expanded Mode	TUAV	62
FTI	Generic	5	Narrow Sector Search (NSS)	ARL-M	63
Available for Future Use	Reserved	6-10	Single Beam Scan (SBS)	ARL-M	64
Attack Control – SATC	Joint STARS	11	Wide Area (WA)	ARL-M	65
Attack Control	Joint STARS	12	Available for Future Use	Reserved	66-80
SATC	Joint STARS	13	GRCA	Reserved	81
Attack Planning - SATC	Joint STARS	14	RRCA	Reserved	82
Attack Planning	Joint STARS	15	Sector Search	Reserved	83
Medium Resolution Sector Search	Joint STARS	16	HORIZON Basic	HORIZON	84
Low Resolution Sector Search	Joint STARS	17	HORIZON High Sensitivity	HORIZON	85
Wide Area Search - GRCA	Joint STARS	18	HORIZON Burn Through	HORIZON	86
Wide Area Search - RRCA	Joint STARS	19	CRESO Acquisition	CRESO	87
Attack Planning – With Tracking	Joint STARS	20	CRESO Count	CRESO	88
Attack Control – With Tracking	Joint STARS	21	Available for Future Use	Reserved	89-93
Available for Future Use	Reserved	22-30	MTI EXO	ASTOR	94
Wide Area MTI (WAMTI)	ASARS-AIP	31	MTI ENDO/EXO	ASTOR	95
Coarse Resolution Search	ASARS-AIP	32	Available for Future Use	Reserved	96-99
Medium Resolution Search	ASARS-AIP	33	Test/Status Mode	Reserved	100
High Resolution Search	ASARS-AIP	34	MTI Spot Scan	Lynx I/II	101
Point Imaging	ASARS-AIP	35	MTI Arc Scan	Lynx I/II	102
Swath MTI (SMTI)	ASARS-AIP	36	HRR/MTI Spot Scan	Lynx I/II	103
Repetitive Point Imaging	ASARS-AIP	37	HRR/MTI Arc Scan	Lynx I/II	104
Monopulse Calibration	ASARS-AIP	38	Available for Future Use	Reserved	105-110
Available for Future Use	Reserved	39-50	GRCA	Global Hawk	111
Search	ASARS-2	51	RRCA	Global Hawk	112
EMTI Wide Frame Search	ASARS-2	52	GMTI-HRR	Global Hawk	113
EMTI Narrow Frame Search	ASARS-2	53	Available for Future Use	Reserved	114-255

A.4.15 Nominal Revisit Interval (J15) (M).

Specifies the nominal revisit interval for the job ID, expressed in deciseconds (tenths of seconds).

A.4.16 Nominal Sensor Position Uncertainty - Along Track (J16) (M).

Nominal estimate of the standard deviation in the estimated horizontal sensor location, expressed in decimetres. It is measured along the sensor track direction defined in field D15 of the Dwell segment.

The No-Statement value is sent when the sensor is unable or unwilling to provide a value. (NOTE: The nominal fields in the Job Definition Segment provide a means for reporting nominal standard deviations and uncertainty values, and are to be used when values are not received by the sensor. More precise values of these or related estimates may be reported in the appropriate fields in either the Dwell Segment or the Target Report Sub-Segment, when the sensor computes them and the communication bandwidth permits the more frequent reporting.)

A.4.17 Nominal Sensor Position Uncertainty - Cross Track (J17) (M).

Nominal estimate of the standard deviation in the estimated horizontal sensor location, measured orthogonal to the track direction, expressed in decimetres.

The No-Statement value is sent when the sensor is unable or unwilling to provide a value.

A.4.18 Nominal Sensor Position Uncertainty – Altitude (J18) (M).

Nominal estimate of the standard deviation of the measured sensor altitude (field D11), expressed in decimetres.

The No-Statement value is sent when the sensor is unable or unwilling to provide a value.

A.4.19 Nominal Sensor Position Uncertainty – Track Heading (J19) (M).

Nominal standard deviation of the estimate of sensor track heading, expressed in degrees.

The No-Statement value is sent when the sensor is unable or unwilling to provide a value.

A.4.20 Nominal Sensor Position Uncertainty – Sensor Speed (J20) (M).

Nominal standard deviation of the estimate of sensor speed, expressed in millimetres per second.

The No-Statement value is sent when the sensor is unable or unwilling to provide a value.

A.4.21 Nominal Sensor Value – Slant Range Standard Deviation (J21) (M).

Nominal standard deviation of the slant range of the reported detection, expressed in metres.

The No-Statement value is sent when the sensor is unable or unwilling to provide a value.

A.4.22 Nominal Sensor Value — Cross Range Standard Deviation (J22) (M).

Nominal standard deviation of the measured cross angle to the reported detection, expressed in degrees as a 16-bit unsigned binary angle.

The No-Statement value is sent when the sensor is unable or unwilling to provide a value.

A.4.23 Nominal Sensor Value —Target Velocity Line-of-Sight Component Standard Deviation (J23) (M).

Nominal standard deviation of the velocity line-of-sight component reported in field D32.7, expressed in centimetres per second.

The No-Statement value is sent when the sensor is unable or unwilling to provide a value.

A.4.24 Nominal Sensor Value —MDV (J24) (M).

Nominal minimum velocity component along the line of sight, which can be detected by the sensor, expressed in decimetres per second.

The No-Statement value is sent when the sensor is unable or unwilling to provide a value.

A.4.25 Nominal Sensor Value —Detection Probability (J25) (M).

Nominal probability that an unobscured ten square-metre target will be detected within the given area of surveillance, assuming the Swerling model appropriate for the particular radar target.

The No-Statement value is sent when the sensor is unable or unwilling to provide a value.

A.4.26 Nominal Sensor Value —False Alarm Density (J26) (M).

The expected density of False Alarms (FA), expressed in decibels ($-10 \log_{10}(d)$, where d is in False Alarms per square metre).

“0” represents $1 \text{ FA} / \text{m}^2$, and 60 represents $10^{-6} \text{ FA} / \text{m}^2$ (i.e. $1 \text{ FA} / \text{km}^2$).

A.4.27 Terrain Elevation Model Used (J27) (M).

An enumeration field indicating the terrain elevation model used for developing the target reports.

The enumeration table for the terrain elevation model is shown in Table A-12.

Table A-12. Terrain Elevation Models

VALUE	TERRAIN ELEVATION MODEL
0	None Specified
1	DTED0 (Digital Terrain Elevation Data, Level 0)
2	DTED1 (Digital Terrain Elevation Data, Level 1)
3	DTED2 (Digital Terrain Elevation Data, Level 2)
4	DTED3 (Digital Terrain Elevation Data, Level 3)
5	DTED4 (Digital Terrain Elevation Data, Level 4)
6	DTED5 (Digital Terrain Elevation Data, Level 5)
7	SRTM1 (Shuttle Radar Topography Mission, Level 1)
8	SRTM2 (Shuttle Radar Topography Mission, Level 2)
9	DGM50 M745 (Digitales Geländemodell 1:50 000)
10	DGM250 (Digitales Geländemodell 1:250 000)
11	ITHD (Interferometric Terrain Data Height)
12	STHD (Stereometric Terrain Data Height)
13	SEDRIS (SEDRIS Reference Model, ISO/IEC 18026)
14-255	Reserved

A.4.28 Geoid Model Used (J28) (M).

An enumeration field indicating the geoid model used for developing the target reports.

The geoid model gives an estimate of mean sea level via a model for the difference between the earth's zero-altitude gravity potential and the WGS 84 ellipsoid. If this field is set, the geodetic height field D32.6 shall be interpreted as an orthometric height (i.e. height above mean sea level), regardless of the status of the elevation model field J27. The enumeration table for the terrain elevation model is shown in A-13

Table A-13. Geoid Models

VALUE	GEOID MODEL
0	None Specified
1	EGM96 (Earth Gravitational Model, Version 1996)
2	GEO96 (Geoid Gravitational Model, Version 1996)
3	Flat Earth
4-255	Reserved

A.5 Dwell Segment and Target Reports

A Dwell Segment is a report on a grouping of zero or more target reports for which the sensor provides a single time, sensor position, reference position on the ground with simple estimates for the observed area at the reported time, and other pertinent data. A Dwell Segment may be associated with a radar dwell but need not be. The Dwell Segment (Table A-14) presents data pertinent to MTI targets. Dwell Segments shall be sent for each logical grouping of target reports. A Dwell Segment shall be transmitted even if no targets are observed. A Dwell Segment may be sent only if the Job ID in the associated Packet Header is not equal to zero (hex 0x00).

Table A-14. Dwell Segment

Field	Type	Field Name		Bytes	Form	Values	Units
D1	M	Existence Mask		8	FL64	Table A-15	
D2	M	Revisit index		2	I16	0 to 65535	
D3	M	Dwell index		2	I16	0 to 65535	
D4	M	Last Dwell of revisit		1	FL8	0,1	Flag Bit
D5	M	Target report count		2	I16	0 to 65535	
D6	M	Dwell time		4	I32	0 to 4 x 10E9	milliseconds
D7	M	Sensor position	Latitude	4	SA32	- 90 to +89.999999958	degrees
D8	M		Longitude	4	BA32	0 to +359.999999916	degrees
D9	M		Altitude	4	S32	-10000 to +2 billion	centimetres
D10	C	Scale factor	Lat scale	4	I32	Sec A.5.10	degrees
D11	C		Long scale	4	I32	Sec A.5.11	degrees
D12	O	Sensor Position uncertainty	Along track	4	I32	0 to 1,000,000	centimetres
D13	O		Cross track	4	I32	0 to 1,000,000	centimetres
D14	O		Altitude	2	I16	0 to 20,000	decimetres
D15	C	Sensor track		2	BA16	0 to 359.9945	degrees
D16	C	Sensor speed		4	I32	0 to 8000000	millimetres/sec
D17	C	Sensor vertical velocity		1	I8	-128 to +127	decimetres/sec
D18	O	Sensor track uncertainty		1	I8	0 to 45	degrees
D19	O	Sensor speed uncertainty		2	I16	0 to 65535	millimetres/sec
D20	O	Vertical velocity uncertainty		2	I16	0 to 65535	centimetres/sec
D21	C	Platform Orientation	Heading	2	BA16	0 to 359.9945	degrees
D22	C		Pitch	2	SA16	-90 to +89.9973	degrees
D23	C		Roll	2	SA16	-90 to +89.9973	degrees
D24	M	Dwell Area	Center Lat	4	SA32	- 90 to + 89.999989	degrees
D25	M		Center Long	4	BA32	0 to +359.999979	degrees
D26	M		Range half width	2	B16	0 to 255.9928	kilometres
D27	M		Dwell ang. half width	2	BA16	0 to 359.9945	degrees
D28	O	Sensor Orientation	Heading	2	BA16	0 to 359.9945	degrees
D29	O		Roll	2	SA16	-90 to +89.9973	degrees
D30	O		Pitch	2	SA16	-90 to +89.9973	degrees
D31	O	Minimum detectable velocity		1	I8	0 to 255	decimetres/sec
D32		<Target Reports>					

A.5.1 Existence Mask (D1) (M).

The Existence Mask, the first field of the Dwell Segment, is an encoded eight-byte field that immediately follows the Segment Header fields and precedes all other Dwell Segment fields. Each field of the Dwell Segment, with the exception of the Existence Mask itself, is represented by a reserved bit within the Existence Mask. Each bit of the Existence Mask indicates whether or not the corresponding field of the Dwell Segment is present in the data stream.

The most-significant bit (bit 7) of the high-order byte (byte 7) corresponds to the first field (D2) following the Existence Mask of the Dwell Segment, where the high-order byte shall be transmitted first. Table A-15 illustrates the mapping of each Dwell Segment field to the corresponding bit position in the 8-byte Existence Mask. A binary level of “1” for a given bit indicates that the corresponding field of the Dwell Segment is present in the data stream and a binary level of “0” indicates that it is not present. Unused bits shall be filled with zeroes.

Table A-15. Dwell Segment Existence Mask Mapping

Byte No.	Bit No.	Field No.	Type	Value	Byte No.	Bit No.	Field No.	Type	Value
7	7	D2	M	1	3	7	D32.3	C	0,1
7	6	D3	M	1	3	6	D32.4	C	0,1
7	5	D4	M	1	3	5	D32.5	C	0,1
7	4	D5	M	1	3	4	D32.6	O	0,1
7	3	D6	M	1	3	3	D32.7	O	0,1
7	2	D7	M	1	3	2	D32.8	O	0,1
7	1	D8	M	1	3	1	D32.9	O	0,1
7	0	D9	M	1	3	0	D32.10	O	0,1
6	7	D10	C	0,1	2	7	D32.11	O	0,1
6	6	D11	C	0,1	2	6	D32.12	C	0,1
6	5	D12	O	0,1	2	5	D32.13	C	0,1
6	4	D13	O	0,1	2	4	D32.14	C	0,1
6	3	D14	O	0,1	2	3	D32.15	C	0,1
6	2	D15	C	0,1	2	2	D32.16	O	0,1
6	1	D16	C	0,1	2	1	D32.17	O	0,1
6	0	D17	C	0,1	2	0	Spare	N/A	0
5	7	D18	O	0,1	1	7	Spare	N/A	0
5	6	D19	O	0,1	1	6	Spare	N/A	0
5	5	D20	O	0,1	1	5	Spare	N/A	0
5	4	D21	C	0,1	1	4	Spare	N/A	0
5	3	D22	C	0,1	1	3	Spare	N/A	0
5	2	D23	C	0,1	1	2	Spare	N/A	0
5	1	D24	M	1	1	1	Spare	N/A	0
5	0	D25	M	1	1	0	Spare	N/A	0
4	7	D26	M	1	0	7	Spare	N/A	0
4	6	D27	M	1	0	6	Spare	N/A	0
4	5	D28	O	0,1	0	5	Spare	N/A	0
4	4	D29	O	0,1	0	4	Spare	N/A	0
4	3	D30	O	0,1	0	3	Spare	N/A	0
4	2	D31	O	0,1	0	2	Spare	N/A	0
4	1	D32.1	C	0,1	0	1	Spare	N/A	0
4	0	D32.2	C	0,1	0	0	Spare	N/A	0

As an example, an Existence Mask in which the first 2 bytes transmitted (bytes 7 and 6) have hexadecimal value 0xFF3F is interpreted to mean that fields D2 through D9 and D12 through D17 exist and are transmitted (as indicated by binary ones in those fields). Fields D10 and D11 (corresponding to Latitude and Longitude Scale Factors) do not exist (as indicated by binary zeroes) and are not transmitted. Table A-16 shows this example for bytes 7 and 6 of the Existence Mask.

Table A-16. Example of Existence Mask

Byte	Byte 7								Byte 6							
Hex	F				F				3				F			
Mask	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1
Field	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17
Xmit?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes

A.5.2 Revisit Index (D2) (M).

The sequential count of a revisit of the bounding area for a given job ID.

A Revisit Index of “0” indicates the first revisit.

A.5.3 Dwell Index (D3) (M).

The temporally sequential count of a dwell within the revisit of a particular bounding area for a given job ID.

A dwell index of “0” indicates the first dwell of the revisit. (NOTE: Revisit counts are allowed to “wrap” when the allowable range of revisits is exceeded.)

A.5.4 Last Dwell of Revisit (D4) (M).

A flag to indicate that this is the last dwell of the revisit.

The Last Dwell of Revisit flag set to “1” indicates there are no additional dwells within that revisit. (NOTE: A Dwell Index, field D3, of “0” and a Last Dwell of Revisit, field D4, of “1” indicates this is the first and only dwell. This allows the concept of a “dwell” to be used by systems that do not utilize multiple dwells or revisits of the radar beam.)

A.5.5 Target Report Count (D5) (M).

A count of the total number of targets reported during this dwell and sent in this Dwell Segment.

A.5.6 Dwell Time (D6) (M).

The elapsed time, expressed in milliseconds, from the midnight at the beginning of the day specified in the Reference Time fields of the Mission Segment to the temporal centre of the dwell.

In this manner, the Dwell Time corresponds to the day's UTC time converted to milliseconds, with the possible addition of multiples of 86400000 for multi-day missions.

A.5.7 Sensor Position – Latitude (D7) (M).

The North-South position of the sensor at the temporal centre of the dwell, expressed as degrees North (positive) or South (negative) of the Equator.

A.5.8 Sensor Position – Longitude (D8) (M).

The East-West position of the sensor at the temporal centre of the dwell, expressed as degrees East (positive) from the Prime Meridian.

A.5.9 Sensor Position – Altitude (D9) (M).

The altitude of the sensor at temporal centre of the dwell, referenced to its position above the WGS 84 ellipsoid, expressed in centimetres.

A.5.10 Scale Factor – Latitude Scale (D10) (C).

A factor which modifies the value of the reported target latitude (Delta Latitude, field D32.4) when it is necessary to send the reduced bandwidth version of the Target Report.

The Latitude Scale factor and Delta Latitude are used in conjunction with the Dwell Area Centre Latitude (field D24) to recover the target latitude as follows:

$$\text{Latitude} = [(\text{Delta Lat}) \times (\text{Lat Scale})] + (\text{Centre Lat}) = [(D32.4) \times (D10)] + (D24)$$

The Latitude Scale shall be chosen in accordance with the guidance given in the AEDP-7 for STANAG 4607.

Field D10 is Conditional and is always sent with field D11. They are sent if and only if the optional difference fields Delta Latitude (D32.4) and Delta Longitude (D32.5) are sent in the Target Report.

A.5.11 Scale Factor – Longitude Scale (D11) (C).

A factor which modifies the value of the reported target longitude (Delta Longitude, field D32.5) when it is necessary to send the reduced bandwidth version of the Target Report.

The Longitude Scale factor and Delta Longitude are used in conjunction with the Dwell Area Centre Longitude (field D25) to recover the target latitude as follows:

$$\text{Longitude} = [(\text{Delta Long}) \times (\text{Long Scale})] + (\text{Centre Long}) = [(D32.5) \times (D11)] + (D25)$$

The Longitude Scale shall be chosen in accordance with the guidance given in the AEDP-7 for STANAG 4607.

Field D11 is Conditional and is always sent with field D10. They are sent if and only if the optional difference fields Delta Latitude (D32.4) and Delta Longitude (D32.5) are sent in the Target Report).

A.5.12 Sensor Position Uncertainty – Along Track (D12) (O).

Estimate of the standard deviation in the estimated horizontal sensor location at the time of the dwell, measured along the sensor track direction (field D15), expressed in centimetres.

Field D12 is Optional. It is always sent with fields D13 and D14.

A.5.13 Sensor Position Uncertainty – Cross-Track (D13) (O).

Estimate of the standard deviation in the estimated horizontal sensor location at the time of the dwell, measured orthogonal to the track direction (field D15), expressed in centimetres.

Field D13 is Optional. It is always sent with fields D12 and D14.

A.5.14 Sensor Position Uncertainty – Altitude (D14) (O).

Standard deviation of the sensor altitude estimate (field D11), expressed in centimetres.

Field D14 is Optional. It is always sent with fields D12 and D13

A.5.15 Sensor Track (D15) (C).

The ground track of the sensor at the time of the dwell, expressed as the angle in degrees (clockwise) from True North.

Field D15 is Conditional and is always sent with fields D16 and D17. They are sent only when the sensor system provides these parameters.

A.5.16 Sensor Speed (D16) (C).

The ground speed of the sensor at the time of the dwell, expressed as millimetres per second.

Field D16 is Conditional and is always sent with fields D15 and D17. They are sent only when the sensor system provides these parameters.

A.5.17 Sensor Vertical Velocity (D17) (C).

The velocity of the sensor in the vertical direction, expressed as decimetres per second.

Field D17 is Conditional and is always sent with fields D15 and D16. They are sent only when the sensor system provides these parameters.

A.5.18 Sensor Track Uncertainty (D18) (O).

The standard deviation of the estimate of the sensor track along the ground, expressed in degrees.

Field D18 is Optional. It is always sent with fields D19 and D20.

A.5.19 Sensor Speed Uncertainty (D19) (O).

The standard deviation of estimate of the sensor speed, expressed in millimetres per second.

Field D19 is Optional. It is always sent with fields D18 and D20.

A.5.20 Sensor Vertical Velocity Uncertainty (D20) (O).

The standard deviation of estimate of the sensor vertical velocity, expressed in centimetres per second.

Field D20 is Optional. It is always sent with fields D18 and D19.

A.5.21 Platform Orientation - Heading (D21) (C).

The heading of the platform at the time of the dwell, expressed as the angle in degrees (clockwise) from True North to the roll axis of the platform, where roll axis is defined in Figure A-1.

Field D21 is Conditional and is always sent with fields D22 and D23. They are sent only when the platform provides these parameters.

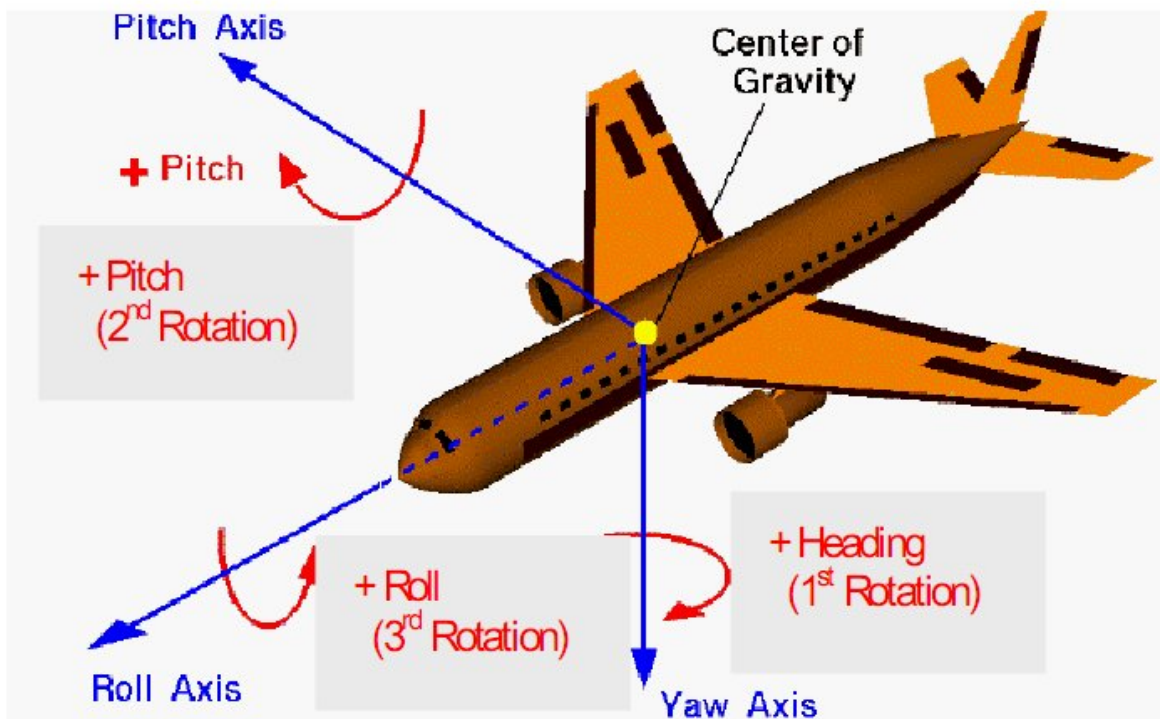


Figure A-1. Platform Orientation Axes (from [4]) (order of rotations: heading, then pitch, then roll)

A.5.22 Platform Orientation - Pitch (D22) (C).

The pitch angle of the platform at the time of the dwell, expressed as the angle in degrees of the rotation of the platform about its pitch axis, as shown Figure A-1, where a positive angle is an upward attitude of the nose of the platform.

Field D22 is Conditional and is always sent with fields D21 and D23. They are sent only when the platform provides these parameters.

A.5.23 Platform Orientation - Roll (D23) (C).

The roll angle of the platform at the time of the dwell, expressed as the angle in degrees of the rotation of the platform about its roll axis, as shown in Figure A-1, where a positive angle is the clockwise direction as viewed from the rear of the platform. (NOTE: The term “Platform Bank Angle” is synonymous with the term “Platform Roll Angle”.)

Field D23 is Conditional and is always sent with fields D21 and D22. They are sent only when the platform provides these parameters.

A.5.24 Dwell Area – Centre Latitude (D24) (M).

The North-South position of the centre of the dwell area, expressed as degrees North (positive) or South (negative) of the Equator.

A.5.25 Dwell Area – Centre Longitude (D25) (M).

The East-West position of the centre of the dwell area, expressed as degrees East (positive) of the Prime Meridian.

A.5.26 Dwell Area – Range Half Extent (D26) (M).

The distance on the earth surface, expressed in kilometres, from the near edge to the centre of the dwell area.

A.5.27 Dwell Area – Dwell Angle Half Extent (D27) (M).

For dwell based radars, one-half of the 3-dB beamwidth, expressed in degrees as a 16-bit unsigned binary angle. For non-dwell based radars, the angle between the beginning of the dwell to the centre of the dwell, as measured from the sensor's position

A.5.28 Sensor Orientation – Heading (D28) (O).

The rotation of the sensor broadside face about the local vertical axis of the platform, expressed in degrees clockwise when viewed from above.

This is the first of three successive rotations from a hypothetical initial position in which the sensor broadside (normal to the sensor face) is in its normal “rest” position (i.e., along the platform roll axis for forward-looking sensors or along the platform pitch axis for side-looking sensors) and the sensor face is nominally level (i.e., the lateral axis of the face is level, pointing along the roll or pitch axis as applicable, and the yaw axis points along the direction of the local vertical). In the case where the sensor is an electronically steerable array (ESA), ‘Sensor Orientation – Heading’ refers to the rotation of the radar beam about the local vertical axis of the platform, and is independent of any mechanical rotation of the sensor.

Field D28 is optional. If at least one of fields D28, D29, or D30 is present, then any omitted field shall represent an angle of zero degrees.

A.5.29 Sensor Orientation – Pitch (D29) (O).

The rotation angle of the sensor normal about the lateral axis of the sensor broadside, which is pointing in the direction defined by the sensor orientation heading angle. It is expressed in degrees, where an angle above the horizontal is positive.

This is the second of three successive rotations from the hypothetical initial position of the sensor, as described above. In the case where the sensor is an electronically steerable array (ESA),

'Sensor Orientation - Pitch' refers to the rotation of the radar beam about the lateral axis of the platform, and is independent of any mechanical rotation of the sensor.

Field D29 is Optional. If at least one of the fields D28, D29, or D30 is present, then any omitted field shall represent an angle of zero degrees.

A.5.30 Sensor Orientation – Roll (D29) (O).

The rotation angle of the sensor about the transverse axis of the sensor broadside, which is pointing in the direction defined by the sensor orientation heading angle. It is expressed in degrees, where a clockwise location is positive, as seen from behind the face of the sensor.

This is the third of three successive rotations from the hypothetical initial position of the sensor, as described above. In the case where the sensor is an electronically steerable array (ESA), 'Sensor Orientation - Roll' refers to the rotation of the radar beam about the transverse axis of the platform, and is independent of any mechanical rotation of the sensor.

Field D30 is Optional. If at least one of the fields D28, D29, or D30 is present, then any omitted field shall represent an angle of zero degrees.

A.5.31 Minimum Detectable Velocity, MDV (D31) (O).

The minimum velocity component, long the line of sight, which can be detected by the sensor; expressed in decimetres per second.

Field D31 is optional.

A.5.32 <Target Reports>.

Table A-17 describes the format for the Target Reports. One target report shall be transmitted for each target observed within the dwell. Targets detected within a dwell may be split among multiple Dwell Segments. Targets detected within a dwell, but by different radar modes or radar processors shall be reported in separate dwell segments. Table A-11 provides a list of radar modes.

Table A-17. Target Report

Field	Type	Field Name		Bytes	Form	Value	Units
D32.1	C	MTI Report Index		2	I16	0 to 65535	
D32.2	C	Target Location	Latitude	4	SA32	- 90 to +89.999989	degrees
D32.3	C		Longitude	4	BA32	0 to +359.999999916	degrees
D32.4	C		Delta Lat	2	S16	- 32768 to + 32767	
D32.5	C		Delta Long	2	S16	- 32768 to + 32767	
D32.6	O		Geo Height	2	S16	- 1000 to + 10000	metres
D32.7	O	V_{RADIAL}		2	S 16	-32768 to +32767	centimetres/sec
D32.8	O	Wrap Velocity		2	I16	0 to 65535	centimetres/sec
D32.9	O	Target SNR		1	S8	-128 to +127	dB
D32.10	O	Target classification		1	E8	Table A-18	
D32.11	O	Target class. probability		1	I8	0 to 100	percent
D32.12	C	Target measurement SD	Slant range	2	I16	0 to 65535	centimetres
D32.13	C		Cross range	2	I16	0 to 65535	decimetres
D32.14	C		Height	1	I8	0 to 255	metres
D32.15	C		V_{RADIAL}	2	I16	0 to 5000	centimetres/sec
D32.16	C	Truth Tag	Application	1	I8	0, 1 to 255	
D32.17	C		Entity	4	I32	0, 1 to 4294967295	

A.5.32.1 MTI Report Index (D32.1) (C).

The sequential count of this MTI report within the dwell.

Field D32.1 is Conditional and must be sent if an HRR report is provided for targets in this dwell.

A.5.32.2 Target Location – High-Resolution Latitude (D32.2) (C).

The North-South position of the reported detection, expressed as degrees North (positive) or South (negative) of the Equator.

Field D32.2 is Conditional and is always sent with field D32.3. They are sent only when the transmission bandwidth permits the use of 4 bytes each for target latitude and longitude. If fields D32.2 and D32.3 are sent, then fields D32.4 and D32.5 are not sent.

A.5.32.3 Target Location – High-Resolution Longitude (D32.3) (C).

The East-West position of the reported detection, expressed as degrees East (positive) of the Prime Meridian.

Field D32.2 is Conditional and is always sent with field D32.3. They are sent only when the transmission bandwidth permits the use of 4 bytes each for target latitude and longitude. If fields D32.2 and D32.3 are sent, then fields D32.4 and D32.5 are not sent.

A.5.32.4 Target Location – Delta Latitude (D32.4) (C).

The North-South position of the reported detection, expressed as degrees North (positive) or South (negative) from the Dwell Area Centre Latitude (the Reference Point) sent in Field D24.

The field shall be sent when it is necessary to send the reduced bandwidth version of the Target Report. Delta Latitude is used in conjunction with the Latitude Scale factor (field D10) and the Dwell Area Centre Latitude (field D24) to recover the target latitude as follows:

$$\text{Latitude} = [(\text{Delta Lat}) \times (\text{Lat Scale})] + (\text{Centre Lat}) = [(D32.4) \times (D10)] + (D24)$$

Field D32.4 is Conditional and is always sent with fields D32.5, D10, and D11. They shall be used when the transmission bandwidth and the number of targets do not permit the use of 4 bytes each for target latitude and longitude. If fields D32.4, D32.5, D10, and D11 are sent, then fields D32.2 and D32.3 are not sent.

A.5.32.5 Target Location – Delta Longitude (D32.5) (C).

The East-West position of the reported detection, expressed as degrees East (positive) from the Dwell Area Centre Longitude (the Reference Point) sent in Field D25.

The field shall be sent when it is necessary to send the reduced bandwidth version of the Target Report. Delta Longitude is used in conjunction with the Longitude Scale factor (field D11) and the Dwell Area Centre Longitude (field D25) to recover the target longitude as follows:

$$\text{Longitude} = [(\text{Delta Lon}) \times (\text{Lon Scale})] + (\text{Centre Lon}) = [(D32.5) \times (D11)] + (D25)$$

Field D32.4 is Conditional and is always sent with fields D32.5, D10, and D11. They shall be used when the transmission bandwidth and the number of targets do not permit the use of 4 bytes each for target latitude and longitude. If fields D32.4, D32.5, D10, and D11 are sent, then fields D32.2 and D32.3 are not sent.

A.5.32.6 Target Location – Geodetic Height (D32.6) (O).

This field reports the geodetic height used within the translation from the target's radar coordinates to the target's geodetic coordinates.

If the geoid model flag (J28) is set, the height shall be interpreted as an orthometric height (i.e. height above mean sea level). If J28 is not set, the height shall be interpreted as a height above the WGS84 ellipsoid (HAE), whether or not an elevation model (field J27) has been used. If fields J27 and/or J28 are not set, elevation or geoid data may also be available from alternative local sources, such as the 100 x 100 geoid height data over the WGS84 ellipsoid, with DTED Level 0 terrain elevation data, which is available over the Internet. Field D32.6 is Optional.

A.5.32.7 Target Velocity Line-Of-Sight Component (D32.7) (O).

The component of velocity for the reported detection, expressed in centimetres per second, corrected for platform motion, along the line of sight between the sensor and the reported detection, where the positive direction is away from the sensor. It may also be known as the Radial Velocity.

Field D32.7 is Optional. If field D32.7 is sent, then field D32.8 shall also be sent.

A.5.32.8 Target Wrap Velocity (D32.8) (O).

Half the velocity aliasing period.

For most radars this is calculable as the effective PRF (i.e., the product of PRF's on CPI's for which the target was detected) multiplied by the effective sensor wavelength divided by four. The target wrap velocity permits trackers to un-wrap velocities for targets with line-of sight components large enough to exceed the first velocity period. When the target's wrap velocity is low compared to the target's expected line-of-sight velocity the tracker may consider adding multiples of twice the target wrap velocity to field D32.7.

Field D32.8 is Optional. If field D32.8 is sent, then field D32.7 shall also be sent.

A.5.32.9 Target SNR (D32.9) (O).

Estimated Signal to Noise ratio (SNR) of the target return, expressed in decibels.

Field D32.9 is optional.

A.5.32.10 Target Classification (D32.10) (O).

An enumeration field denoting the classification of the target.

Classification types shall include wheeled, non-wheeled (i.e. tracked), helicopter, low-slow flyer, rotating antenna, maritime, beacon, and unknown, for both live and simulated targets. If a target cannot be classified, it shall be marked as "unknown". The enumeration table for target classification is shown in Table A-18

Field D32.10 is optional.

Table A-18. Target Classification

VALUE	TARGET CLASSIFICATION
0	No Information, Live Target
1	Tracked Vehicle, Live Target
2	Wheeled Vehicle, Live Target
3	Rotary Wing Aircraft, Live Target
4	Fixed Wing Aircraft, Live Target
5	Stationary Rotator, Live Target
6	Maritime, Live Target
7	Beacon, Live Target
8	Amphibious, Live Target
9-125	Reserved
126	Other, Live Target
127	Unknown, Live Target
128	No Information, Simulated Target
129	Tracked Vehicle, Simulated Target
130	Wheeled Vehicle, Simulated Target
131	Rotary Wing Aircraft, Simulated Target
132	Fixed Wing Aircraft, Simulated Target
133	Stationary Rotator, Simulated Target
134	Maritime, Simulated Target
135	Beacon, Simulated Target
136	Amphibious, Simulated Target
137-253	Reserved
254	Other, Simulated Target
255	Unknown, Simulated Target

A.5.32.11 Target Classification Probability (D32.11) (O).

The estimated probability that the target classification appearing in field D32.10 is correctly classified.

Field D32.11 is Optional.

A.5.32.12 Target Measurement Uncertainty – Slant Range (D32.12) (C).

The standard deviation of the estimated slant range of the reported detection, expressed in centimetres.

Field D32.12 is conditional. It is sent only if fields 12 is C D12, D13, and D14 of the Dwell Segment are sent, and shall be sent with fields D32.13, D32.14, and DD32.15, if they are available.

A.5.32.13 Target Measurement Uncertainty – Cross Range (D32.13) (C).

The standard deviation of the position estimate, in the cross-range direction, of the reported detection, expressed in decimetres.

Field D32.13 is Conditional. It is sent only if fields D12, D13, and D14 of the Dwell Segment are sent, and shall be sent with fields D32.12, D32.14, and D32.15, if they are available.

A.5.32.14 Target Measurement Uncertainty – Height (D32.14) (C).

The standard deviation of the estimated geodetic height reported in field D32.6, expressed in metres.

Field D32.14 is conditional. It is sent only if fields D12, D13, and D14 of the Dwell Segment and D32.7 of the Target Report are sent, and shall be sent with fields D32.12, D32.13, and D32.15, if they are available.

A.5.32.15 Target Measurement Uncertainty –Target Radial Velocity (D32.15) (C).

The standard deviation of the measured line-of-sight velocity component reported in field D32.7, expressed in centimetres per second.

Field D32.15 is conditional. It is sent only if fields D12, D13, and D14 of the Dwell Segment and D32.7 of the Target Report are sent, and shall be sent with fields D32.12, D32.13, and D32.14, if they are available.

A.5.32.16 Truth Tag – Application (D32.16) (C).

The Truth Tag – Application is the Application Field, truncated to 8 bits, from the Entity State Protocol Data Unit (PDU) used to generate the MTI Target. If the MTI target is the result of more than one Entity State PDU, then the value of the target with the highest instantaneous radar return is passed in this field.

A value of all zeroes indicates that no information is available regarding the Entity State PDU that was used to generate the MTI Target being passed. For simulated data, the Truth Tag relates targets back to the truth data, which is represented using Distributed Interactive Simulation (DIS Entity State PDUs).

Field D32.16 is Conditional and is sent only if the MTI Target in this Report is simulated. It is always sent with field D32.17.

A.5.32.17 Truth Tag – Entity (D32.17) (C).

The Truth Tag - Entity is the Entity Field from the Entity State PDU used to generate the MTI Target. It is passed as a 32-bit value, in the same format as the Entity State PDU Identity value.

A value of all zeros indicates that no information is available regarding the Entity State PDU that was used to generate the MTI Target being passed. For simulated data, the Truth Tag relates targets back to the truth data, which is represented using Distributed Interactive Simulation (DIS Entity State PDUs).

Field D32.17 is Conditional and is sent only if the MTI Target in this Report is simulated. It is always sent with field D32.16.

A.6 Platform Location Segment

The Platform Location Segment (Table A-19) provides information pertaining to the location of the sensor platform during periods when the sensor is not collecting data. It shall be sent as required during periods in which the sensor is not collecting data, such as enroute to an orbit location or during a turn.

Table A-19. Platform Location Segment

Field	Type	Field name	Bytes	Form	Values	Units
L1	M	Location Time	4	I32	0 to 4 x 10E9	milliseconds
L2	M	Platform position	Latitude	SA32	- 90 to +89.9999999	degrees
L3	M		Longitude	BA32	0 to +359.9999999	degrees
L4	M		Altitude	S32	-10000 to +8000000	decimetres
L5	M	Platform track	2	BA16	0 to 359.9945	degrees
L6	M	Platform Speed	4	I32	0 to 8000000	millimetres/sec
L7	M	Platform Vertical Velocity	1	S8	-128 to +127	millimetres/sec

A.6.1 Location Time (L1) (M).

The elapsed time, expressed in milliseconds, from midnight at the beginning of the day specified in the Reference Time fields of the Mission Segment to the time the report is prepared.

In this manner, the Location Time corresponds to the day's UTC time converted to milliseconds, with the possible addition of multiples of 86400000 for multi-day missions.

A.6.2 Platform Position – Latitude (L2) (M).

The North-South position of the platform at the time the report is prepared, expressed as degrees North (positive) or South (negative) of the Equator.

A.6.3 Platform Position – Longitude (L3) (M).

The East-West position of the platform at the time the report is prepared, expressed as degrees East (positive) from the Prime Meridian.

A.6.4 Platform Position – Altitude (L4) (M).

The altitude of the platform at the time the report is prepared, referenced to its position above the WGS 84 ellipsoid, expressed in centimetres.

A.6.5 Platform Track (L5) (M).

The ground track of the platform at the time at the time the report is prepared, expressed as the angle in degrees (clockwise) from True North.

A.6.6 Platform Speed (L6) (M).

The ground speed of the platform at the time at the time the report is prepared, expressed in millimetres per second.

A.6.7 Platform Vertical Velocity (L7) (M).

The velocity of the platform in the vertical direction, expressed as decimetres per second.

Annex B Compendium of Proposed STANAG 4607 Segment Extensions

This section provides tables and descriptions of the proposed new extensions for use with the core set of Headers and Segments identified in Annex A. These extensions and the base segments they are attached to (described in Annex A) form the segment set that will be implemented by DRDC in support of RADARSAT-2 GMTI data. In the following tables, entries in blue indicate quantities which will always be reported by RADARSAT-2 GMTI, those in green indicate quantities which can be provided depending on the users' needs and bandwidth considerations, while those in red will not be implemented by RADARSAT-2 GMTI.

B.1 Advanced Dwell Segment Extension

An Advanced Dwell Segment Extension is a report on a grouping of zero or more target reports for which the sensor provides a single time, sensor position, reference position on the ground with simple estimates for the observed area at the reported time, and other pertinent data. An Advanced Dwell Segment Extension may be associated with a radar dwell but need not be. The Advanced Dwell Segment Extension (Table B-1) presents data pertinent to GMTI targets detected by GMTI sensors, including airborne and spaceborne sensors. Dwell Segments shall be sent for each logical grouping of target reports, and an Advanced Dwell Segment Extension may optionally be sent for each dwell segment. An Advanced Dwell Segment Extension may optionally be transmitted, in conjunction with a Dwell Segment, if no targets are observed.

Table B-1. Advanced Dwell Segment Extension

Field	Type	Field Name		Bytes	Form	Value Range	Units
AD1	M	Existence Mask		8	FL64	Table B-2	
AD2	M	Revisit Index		2	I16	0 to 65535	
AD3	M	Dwell Index		2	I16	0 to 65535	
AD4	O	Dwell minimum range		4	I32	0 to 4294967295	centimetres
AD5	C	Reference Coordinate System		1	E8	Per para. 4.1.5	
AD6	O	Slant-Range sample Spacing		2	I16	0 to 65535	centimetres
AD7	O	Cross-Range Sample Spacing		2	I16	0 to 65535	centimetres
AD8	O	Slant-Range Resolution		2	I16	0 to 65535	centimetres
AD9	O	Cross-Range Resolution		2	I16	0 to 65535	centimetres
AD10	C	Platform Position	X	8	S64	(-2^{63}) to $(2^{63} - 1)$	millimetres
AD11	C		Y	8	S64	(-2^{63}) to $(2^{63} - 1)$	millimetres
AD12	C		Z	8	S64	(-2^{63}) to $(2^{63} - 1)$	millimetres
AD13	O	Platform Position Uncertainty (one standard deviation)	X	4	I32	0 to 4294967295	millimetres
AD14	O		Y	4	I32	0 to 4294967295	millimetres
AD15	O		Z	4	I32	0 to 4294967295	millimetres
AD16	C	Platform Velocity	X-Prime	4	S32	-2147483648 to 2147483647	millimetres/sec
AD17	C		Y- Prime	4	S32	-2147483648 to 2147483647	millimetres/sec
AD18	C		Z- Prime	4	S32	-2147483648 to 2147483647	millimetres/sec
AD19	O	Platform Velocity Uncertainty	X-Prime	2	I16	0 to 65535	millimetres/sec
AD20	O		Y- Prime	2	I16	0 to 65535	millimetres/sec
AD21	O		Z- Prime	2	I16	0 to 65535	millimetres/sec
AD22	C	High Resolution Platform Orientation	Yaw	4	BA32	0 to +359.999979	degrees
AD23	C		Pitch	4	BA32	0 to +359.999979	degrees
AD24	C		Roll	4	BA32	0 to +359.999979	degrees
AD25	O	Sensor Position Vector	X	4	S32	-2147483648 to 2147483647	millimetres
AD26	O		Y	4	S32	-2147483648 to 2147483647	millimetres
AD27	O		Z	4	S32	-2147483648 to 2147483647	millimetres
AD28	O	High Resolution Sensor Orientation	Yaw	4	BA32	0 to +359.999979	degrees
AD29	O		Pitch	4	BA32	0 to +359.999979	degrees
AD30	O		Roll	4	BA32	0 to +359.999979	degrees
AD31	O	Dwell Area Centre Elevation		2	S16	-1000 to 10000	metres
AD32		< Advanced Target Report Extensions >				See Table 4-1.2	

B.1.1 Existence Mask (AD1) (M).

The Existence Mask, the first field of the Advanced Dwell Segment Extension, is an encoded eight-byte field that immediately follows the Segment Header fields and precedes all other Advanced Dwell Segment Extension fields. Each field of the Advanced Dwell Segment Extension, with the exception of the Existence Mask itself, is represented by a reserved bit within the Existence Mask. Each bit of the Existence Mask indicates whether or not the corresponding field of the Dwell Segment is present in the data stream.

The most-significant bit (bit 7) of the high-order byte (byte 7) corresponds to the first field (AD2) following the Existence Mask of the Advanced Dwell Segment Extension, where the high-order byte shall be transmitted first. Figure 4-1 illustrates the mapping of each Advanced Dwell Segment Extension field to the corresponding bit position in the 8-byte Existence Mask. A binary level of “1” for a given bit indicates that the corresponding field of the Advanced Dwell Segment Extension is present in the data stream and a binary level of “0” indicates that it is not present. Unused bits shall be filled with zeroes.

Table B-2. Advanced Dwell Segment Extension Existence Mask Mapping

Byte No.	Bit No.	Field No.	Type	Value	Byte No.	Bit No.	Field No.	Type	Value
7	7	AD2	M	1	3	7	AD32.3	O	0,1
7	6	AD3	M	1	3	6	AD32.4	O	0,1
7	5	AD4	O	1	3	5	AD32.5	O	0,1
7	4	AD5	C	0,1	3	4	AD32.6	O	0,1
7	3	AD6	O	0,1	3	3	AD32.7	O	0,1
7	2	AD7	O	0,1	3	2	AD32.8	O	0,1
7	1	AD8	O	0,1	3	1	AD32.9	O	0,1
7	0	AD9	O	0,1	3	0	AD32.10	O	0,1
6	7	AD10	C	0,1	2	7	AD32.11	O	0,1
6	6	AD11	C	0,1	2	6	AD32.12	O	0,1
6	5	AD12	C	0,1	2	5	AD32.13	C	0,1
6	4	AD13	O	0,1	2	4	AD32.14	C	0,1
6	3	AD14	O	0,1	2	3	AD32.15	C	0,1
6	2	AD15	O	0,1	2	2	AD32.16	C	0,1
6	1	AD16	C	0,1	2	1	AD32.17	C	0,1
6	0	AD17	C	0,1	2	0	AD32.18	C	0,1
5	7	AD18	C	0,1	1	7	Spare	N/A	0
5	6	AD19	O	0,1	1	6	Spare	N/A	0
5	5	AD20	O	0,1	1	5	Spare	N/A	0
5	4	AD21	O	0,1	1	4	Spare	N/A	0
5	3	AD22	C	0,1	1	3	Spare	N/A	0
5	2	AD23	C	0,1	1	2	Spare	N/A	0
5	1	AD24	C	0,1	1	1	Spare	N/A	0
5	0	AD25	O	0,1	1	0	Spare	N/A	0
4	7	AD26	O	0,1	0	7	Spare	N/A	0
4	6	AD27	O	0,1	0	6	Spare	N/A	0
4	5	AD28	O	0,1	0	5	Spare	N/A	0
4	4	AD29	O	0,1	0	4	Spare	N/A	0
4	3	AD30	O	0,1	0	3	Spare	N/A	0
4	2	AD31	O	0,1	0	2	Spare	N/A	0
4	1	AD32.1	M	1	0	1	Spare	N/A	0
4	0	AD32.2	O	0,1	0	0	Spare	N/A	0

B.1.2 Revisit Index (AD2) (M).

The sequential count of a revisit of the bounding area for a given job ID, where a Revisit Index of “0” indicates the first revisit.

The Revisit Index provides linkage between the Advanced Dwell Segment Extension and the baseline Dwell Segment, and must be the same as the Revisit Index of the baseline Dwell Segment.

B.1.3 Dwell Index (AD3) (M).

The temporally sequential count of a dwell within the revisit of a particular bounding area for a given job ID.

A dwell index of “0” indicates the first dwell of the revisit. (NOTE: Revisit counts are allowed to “wrap” when the allowable range of revisits is exceeded.) The Dwell Index provides linkage between the Advanced Dwell Segment Extension and the baseline Dwell Segment, and must be the same as the Dwell Index of the baseline Dwell Segment.

B.1.4 Dwell minimum range (AD4) (O).

The minimum measured range for this dwell, expressed in centimetres (i.e. the range to the first pixel in the swath).

B.1.5 Reference Coordinate System (AD5) (C).

An enumeration table that identifies the reference coordinate system for the platform. Coordinate systems are listed in Table B-3.

Field AD5 is Conditional and is always sent with Sensor Position fields (AD10, AD11, and AD12), Sensor Velocity (AD16, AD17, and AD18), and Sensor Position Vector (AD25, AD26, and AD27). They are sent only when the platform provides these parameters.

Table B-3. Reference Coordinate Systems

COORDINATE SYSTEM	VALUE
Unidentified	0
GEI: Geocentric Equatorial Inertial, also known as True Equator and True Equinox of Date, True of Date (TOD), ECI, or GCI	1
J2000: Geocentric Equatorial Inertial for epoch J2000.0 (GEI2000), also known as Mean Equator and Mean Equinox of J2000.0	2
GEO: Geographic, also known as Greenwich Rotating Coordinates (GRC), or Earth-fixed Greenwich (EFG)	3
Available for Future Use	4-255

B.1.6 Slant Range Sample Spacing (AD6) (O).

Slant range pixel spacing after over sampling, expressed in centimetres.

Field AD6 is Optional

B.1.7 Cross Range Sample Spacing (AD7) (O).

Cross range pixel spacing after over sampling, expressed in centimetres.

Field AD7 is Optional.

B.1.8 Slant Range Resolution (AD8) (O).

The 3dB range impulse response of the radar, expressed in centimetres.

Field AD9 is Optional

B.1.9 Cross Range Resolution (AD9) (O).

The 3dB cross range impulse response of the radar, expressed in centimetres.

Field AD9 is Optional

B.1.10 Platform Position – X Coordinate (AD10) (C).

The coordinate of the platform position in the X direction of the reference coordinate system defined in field AD5, expressed in millimetres.

Field AD10 is Conditional and is always sent with Reference Coordinate System (AD5) and fields AD11 and AD12. They are sent only when the platform provides these parameters.

B.1.11 Platform Position – Y Coordinate (AD11) (C).

The coordinate of the platform position in the Y direction of the reference coordinate system defined in field AD5, expressed in millimetres.

Field AD11 is Conditional and is always sent with Reference Coordinate System (AD5) and fields AD10 and AD12. They are sent only when the platform provides these parameters.

B.1.12 Platform Position – Z Coordinate (AD12) (C).

The coordinate of the platform position in the Z direction of the reference coordinate system defined in field AD5, expressed in millimetres.

Field AD12 is Conditional and is always sent with Reference Coordinate System (AD5) and fields AD10 and AD11. They are sent only when the platform provides these parameters.

B.1.13 Platform Position Uncertainty – X Coordinate (AD13) (O).

Estimate of the standard deviation in the platform position at the time of the dwell, measured in the X direction of the reference coordinate system defined in field AD5, expressed in millimetres.

Field AD13 is Optional. It is always sent with fields AD5, AD14, and AD15.

B.1.14 Platform Position Uncertainty – Y Coordinate (AD14) (O).

Estimate of the standard deviation in the platform position at the time of the dwell, measured in the Y direction of the reference coordinate system defined in field AD5, expressed in millimetres.

Field AD14 is Optional. It is always sent with fields AD5, AD13, and AD15.

B.1.15 Platform Position Uncertainty – Z Coordinate (AD15) (O).

Estimate of the standard deviation in the platform position at the time of the dwell, measured in the Z direction of the reference coordinate system defined in field AD5, expressed in millimetres.

Field AD15 is Optional. It is always sent with fields AD5, AD13, and AD14

B.1.16 Platform Velocity – X- Prime (AD16) (C).

The velocity of the platform in the X direction of the reference coordinate system defined in field AD5, expressed as millimetres per second, at the time of the dwell.

Field AD16 is Conditional and is always sent with fields AD5, AD17, and AD18. They are sent only when the sensor system provides these parameters.

B.1.17 Platform Velocity – Y- Prime (AD17) (C).

The velocity of the platform in the Y direction of the reference coordinate system defined in field AD5, expressed as millimetres per second, at the time of the dwell.

Field AD17 is Conditional and is always sent with fields AD5, AD16, and AD18. They are sent only when the sensor system provides these parameters.

B.1.18 Platform Velocity – Z- Prime (AD18) (C).

The velocity of the platform in the Z direction of the reference coordinate system defined in field AD5, expressed as millimetres per second, at the time of the dwell.

Field AD18 is Conditional and is always sent with fields AD5, AD16, and AD17. They are sent only when the sensor system provides these parameters.

B.1.19 Platform Velocity Uncertainty – X-Prime (AD19) (O).

The standard deviation of the estimate of the platform velocity in the X direction of the reference coordinate system defined in field AD5, expressed as millimetres per second.

Field AD19 is Optional. It is always sent with fields AD5, AD20, and AD21.

B.1.20 Platform Velocity Uncertainty – Y-Prime (AD20) (O).

The standard deviation of the estimate of the platform velocity in the Y direction of the reference coordinate system defined in field AD5, expressed as millimetres per second.

Field AD20 is Optional. It is always sent with fields AD5, AD19, and AD21.

B.1.21 Platform Velocity Uncertainty – Z-Prime (AD21) (O).

The standard deviation of the estimate of the platform velocity in the Z direction of the reference coordinate system defined in field AD5, expressed as millimetres per second.

Field AD21 is Optional. It is always sent with fields AD5, AD19, and AD20.

B.1.22 High Resolution Platform Orientation - Yaw (AD22) (C).

The rotation angle of the platform about the platform yaw axis at the time of the dwell, expressed in degrees, from the Sensor Velocity vector defined in fields AD16-AD18 to the platform roll axis, where platform yaw axis and platform roll axis are defined in Figure B-1.

A positive platform yaw angle is in a clockwise direction when viewed from above. The High Resolution Platform Orientation describes the coordinate systems used for spaceborne platforms and provides increased resolution compared to the Platform Orientation field provided in the baseline (airborne) dwell segment. Refer to figure A-1 in Annex A for the description of coordinate systems for airborne platforms.

Field AD22 is Conditional and is always sent with fields AD23 and AD24. They are sent only when the platform provides these parameters.

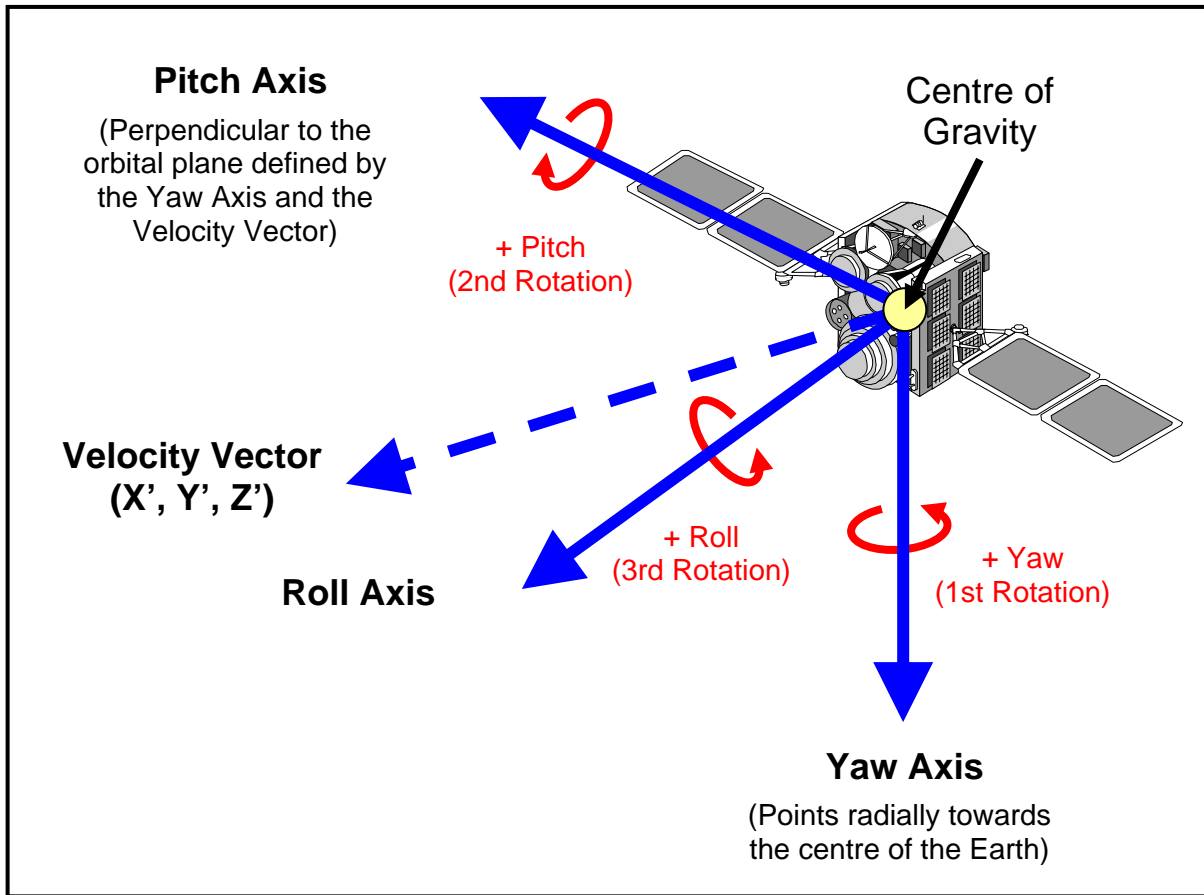


Figure B-1. Platform Orientation Axes (from [5])
(order of rotation: Yaw, then Pitch, then Roll.)

B.1.23 High Resolution Platform Orientation - Pitch (AD23) (C).

The rotation angle of the platform about the platform pitch axis at the time of the dwell, as defined in Figure B-1, expressed in degrees. A positive pitch angle is a rotation about the Platform Pitch Axis, bringing the Platform Yaw Axis in the direction of the Sensor Velocity vector defined in fields AD16-AD18.

Field AD23 is Conditional and is always sent with fields AD22 and AD24. They are sent only when the platform provides these parameters.

B.1.24 High Resolution Platform Orientation - Roll (AD24) (C).

The rotation angle of the platform about the platform roll axis at the time of the dwell, as defined in Figure B-1, expressed in degrees. A positive platform roll angle is the clockwise direction as viewed in the general direction of the Platform Velocity vector defined in fields AD16-AD18.

Field AD24 is Conditional and is always sent with fields AD22 and AD23. They are sent only when the platform provides these parameters.

B.1.25 Sensor Position Vector – X Coordinate (AD25) (O).

The vector from the Platform Position (platform centre of gravity) to the Sensor Position (phase centre of the sensor) in the X direction of the reference coordinate system defined in field AD5, expressed in millimetres.

Field AD25 is Optional. It is always sent with fields AD26 and AD27.

B.1.26 Sensor Position Vector – Y Coordinate (AD26) (O).

The vector from the Platform Position (platform centre of gravity) to the Sensor Position (phase centre of the sensor) in the Y direction of the reference coordinate system defined in field AD5, expressed in millimetres.

Field AD26 is Optional. It is always sent with fields AD25 and AD27.

B.1.27 Sensor Position Vector – Z Coordinate (AD27) (O).

The vector from the Platform Position (platform centre of gravity) to the Sensor Position (phase centre of the sensor) in the Z direction of the reference coordinate system defined in field AD5, expressed in millimetres.

Field AD27 is Optional. It is always sent with fields AD25 and AD26.

B.1.28 High Resolution Sensor Orientation – Yaw (AD28) (O).

High Resolution Sensor Orientation describes the pointing attitude of the sensor in terms of Yaw, Pitch, and Roll. These values refer to the successive rotations from a nominal sensor “rest” position, and result in a pointing vector that coincides with the radar “beam” from the sensor. This pointing vector describes the orientation of the radar beam, and is independent of any mechanical articulation used to point the beam. (Refer to AEDP-7, Annex E for additional information.) High Resolution Sensor Orientation provides increases resolution compared to the Sensor Orientation field provided in the baseline dwell segment.

High Resolution Sensor Orientation – Yaw describes the rotation of the sensor/beam about the sensor yaw axis, as defined in Figure B-1, expressed in degrees clockwise when viewed from above.

This is the first of three successive rotations from a hypothetical initial position in which the sensor broadside (normal to the sensor face) is in its nominal “rest” position. For downward-looking space-based sensors, the “rest” position will be with the sensor/beam facing towards nadir and the principal axis of the sensor will be parallel to the platform roll axis. When in the “rest” position, the sensor roll, pitch, and yaw axes are parallel to the platform roll, pitch, and yaw axes, respectively. For a “body mounted” sensor, whether an electronically scanned array (ESA) or a reflector, the High Resolution Sensor Orientation fields (AD28, AD29, AD30) refer to the orientation of the sensor field of view, or “beam”. For an “articulated” sensor, the High Resolution Sensor Orientation fields (AD28, AD29, AD30) refer to the orientation of the sensor field of view, or “beam”, and are independent of the physical orientation of the sensor face.

Field AD28 is Optional. If at least one of fields AD28, AD29, or AD30 is present, then any omitted field shall represent an angle of zero degrees.

B.1.29 High Resolution Sensor Orientation – Pitch (AD29) (O).

The rotation angle of the sensor/beam about the sensor pitch axis at the time of the dwell, as defined in Figure B-1, expressed in degrees.

As viewed from the “rest” position, a positive pitch angle is a rotation about the Sensor Pitch Axis, bringing the Sensor Yaw Axis in the direction of the Sensor Velocity vector defined in fields AD16-AD18. This is the second of three successive rotations from the hypothetical initial position of the sensor, as described above.

Field AD29 is Optional. If at least one of fields AD28, AD29, or AD30 is present, then any omitted field shall represent an angle of zero degrees.

B.1.30 High Resolution Sensor Orientation – Roll (AD30) (O).

The rotation angle of the sensor/beam about the sensor roll axis at the time of the dwell, as defined in Figure B-1, expressed in degrees.

A positive roll angle is the clockwise direction as viewed in the general direction of the Sensor Velocity vector defined in fields AD16-AD18. This is the third of three successive rotations from the hypothetical initial position of the sensor, as described above.

Field AD30 is Optional. If at least one of fields AD28, AD29, or AD30 is present, then any omitted field shall represent an angle of zero degrees.

B.1.31 Dwell Area Centre Elevation (AD31) (O)

Dwell Area Centre Elevation, expressed in metres.

This information supplements Dwell Area Centre Latitude (D24) and Dwell Area Centre Longitude (D25) in the STANAG 4607 Dwell Segment. Field AD31 is Optional.

B.1.32 < Advanced Target Report Extensions >.

Table B-4 describes the format for the Advanced Target Report Extensions. One Target Report Extension shall be transmitted for each target observed within the dwell. Targets detected within a dwell may be split among multiple Advanced Dwell Segment Extensions. Targets detected within a dwell but detected by different radar modes or radar processors shall be reported in separate Advanced Dwell Segments

Table B-4. Advanced Target Report Extension

Field	Type	Field Name		Bytes	Form	Value Range	Units
AD32.1	M	MTI Report Index		2	I16	0 to 65535	none
AD32.2	O	Target Slant Range		4	I32	0 to 4294967296	centimetres
AD32.3	O	Target Slow Time		2	S32	-21474836548 to +21474836547	Ten Nanoseconds
AD32.4	O	Target Sine Left Angle		4	S32	-2147483648 to +2147483647	1/2147483648
AD32.5	O	Target Sine Up Angle		4	S32	-21474836548 to +21474836547	1/2147483648
AD32.6	O	Target Velocity Ground Range Component		2	S16	-32768 to +32767, where + means increasing range away from the sensor	centimetres/sec
AD32.7	O	Target Velocity Cross Range Component		2	S16	-32768 to +32767, where + is in the direction of platform motion	centimetres/sec
AD32.8	O	Target Ground Speed		2	I16	0 to 65535	centimetres/sec
AD32.9	O	Target Heading		4	BA32	0 to +359.999979	degrees
AD32.10	O	Target Wrap Range		4	I32	0 to 4294967295	centimetres
AD32.11	O	Target RCS		2	S16	-32768 to +32767	1/100 dBsm
AD32.12	O	Target Incidence Angle		2	SA16	0 to +89.999999958	degrees
AD32.13	C	Target Measurement Uncertainty (one standard deviation)	Target Sine Left Angle	2	I16	0 to 32767	1/32767
AD32.14	C		Target Sine Up Angle	2	I16	0 to 32767	1/32767
AD32.15	C		Target Velocity Ground Range Component	2	I16	0 to 65535	millimetres/sec
AD32.16	C		Target Velocity Cross Range Component	2	I16	0 to 65535	millimetres/sec
AD32.17	C		Target Ground Speed	2	I16	0 to 65535	millimetres/sec
AD32.18	C		Target Heading	2	SA16	0 to +89.999999958	degrees

B.1.32.1 MTI Report Index (AD32.1) (M).

The sequential count of this MTI report within the dwell.

The MTI Report Index provides linkage between target reports in the Advanced Dwell Segment Extension and target reports in the baseline Dwell Segment, and must be the same as the MTI Report Index of target reports in the baseline Dwell Segment.

B.1.32.2 Target Slant Range (AD32.2) (O).

Measured slant range in centimetres from the sensor to the target.

This field is optional. If Target Slant Range is sent, then its uncertainty (field D32.12 in the baseline Target Report) must also be sent.

B.1.32.3 Target Slow Time (AD32.3) (O).

The time at which the centre of the main beam crosses the target, expressed as an offset in tens of nanoseconds from the dwell time.

For a sensor looking broadside at a flat earth or non-rotating ellipsoidal earth, this is the time at which the Doppler shift between the target and the platform is zero (i.e. the point of closest approach of the platform to the target). See Appendix E in the AEDP-7 for more information. This field is Optional.

B.1.32.4 Target Sine Left Angle (AD32.4) (O).

Measured target angle leftward from the look vector defined by the sensor position (Fields AD25 to AD27) and orientation (Fields AD28 to AD30).

Let x, y, and z be a Cartesian coordinate system centred on the antenna, such that the z axis is in the direction of the sensor look vector. The x axis is normal to the look vector, in the scan direction closest to horizontal, oriented leftward when looking outward from the antenna. The y axis is the cross product of the z and x axes. Then for target coordinates x, y, z, the target sine left angle is:

$$u = \frac{x}{\sqrt{x^2 + y^2 + z^2}}$$

This value is unitless, and is expressed with a precision of $1/2^{31}$. Thus, the integer 1859775394 represents a target left angle of 60 degrees, since

$$\sin(60^\circ) = \frac{\sqrt{3}}{2} = \frac{1859775394}{2^{31}} = \frac{1859775394}{2147483648}$$

Target sine left angle should be sent for an electronically scanned antenna where the angle measurement uncertainty is best described in sine space.

This field is optional. If Target Sine Left Angle is sent, then its uncertainty (field AD32.12) should also be sent, but the Target Cross Range Uncertainty (D32.13 in the baseline Target Report) need not be sent.

B.1.32.5 Target Sine Up Angle: (AD32.5) (O).

Measured target angle leftward from the look vector defined by the sensor position (Fields AD25 to AD27) and orientation (Fields AD28 to AD30).

Let x, y, and z be a Cartesian coordinate system centred on the antenna, such that the z axis is in the direction of the sensor look vector. The x axis is normal to the look vector, in the scan direction closest to horizontal, oriented leftward when looking outward from the antenna. The y axis is the cross product of the z and x axes. Then for target coordinates x, y, z, the target sine up angle is:

$$v = \frac{y}{\sqrt{x^2 + y^2 + z^2}}$$

Target sine up angle should be sent for an electronically scanned antenna where the angle measurement uncertainty is best described in sine space.

This field is optional. If Target Sine Up Angle is sent, then its uncertainty (AD32.14) should also be sent, but the Target Cross Range Uncertainty (D32.13 in the baseline Target Report) need not be sent.

B.1.32.6 Target Velocity Ground Range Component (AD32.6) (O).

The component of the ground velocity for the reported detection, in the range direction, corrected for platform motion. It is reported in centimetres per second and the positive direction is away from the sensor.

Note that this is simply the target radial velocity component (D32.7 in the baseline Target Report) projected onto the ground. This field is Optional. If Target Velocity Ground Range Component is sent, then its uncertainty (AD32.15) should also be sent.

B.1.32.7 Target Velocity Cross-Range Component (AD32.7) (O).

The component of the ground velocity for the reported detection, in the cross-range direction, corrected for platform motion. For a side looking sensor, the cross-range direction is along the sensor track. It is reported in centimetres per second and the positive direction is in the direction of the platform motion.

This field is Optional. If Target Velocity Cross-Range Component is sent, then its uncertainty (AD32.16) should also be sent.

B.1.32.8 Target Ground Speed (AD32.8) (O).

The ground speed of the target, reported in centimetres per second.

This field is Optional. If Target Ground Speed is sent, then its uncertainty (AD32.17) should also be sent.

B.1.32.9 Target Heading (AD32.9) (O).

The true heading of the target, reported in degrees from true north measured in the counterclockwise direction.

This field is Optional. If Target Heading is sent, then its uncertainty (AD32.18) should also be sent.

B.1.32.10 Target Wrap Range (AD32.10) (O).

The range aliasing distance.

The target wrap range permits MTI trackers to un-wrap aliased measured slant ranges. When the target's wrap range is small compared to the expected slant range, the tracker may consider adding multiples of the wrap range to the measured slant range (AD32.2). It should be sent if the wrap range is smaller than plausible target slant ranges (e.g. if there were too many missed detections to resolve the range ambiguity).

This field is Optional. If it is sent, then the target slant range (AD32.2) shall also be sent.

B.1.32.11 Target Radar Cross Section (AD32.11) (O).

The target radar cross section in hundredths of a dB, relative to a square metre (dBsm).

$$RCS(dBsm) = 10 \log \left(\frac{RCS(m^2)}{1m^2} \right)$$

The integer range of values can accommodate RCS from -327.68 to 327.67 dBsm.

This field is Optional

B.1.32.12 Target Incidence Angle (AD32.12) (O).

The incidence angle at the target, reported in degrees.

This is the angle between the normal to the WGS ellipsoid at the target location and the slant range (or sensor-target line of sight) vector. In a flat earth model (i.e. if field J28 is set to 3), the

incidence angle is equal to the elevation angle (The angle between the slant range and nadir vectors). This field is Optional.

B.1.32.13 Target Measurement Uncertainty – Target Sine Left Angle (AD32.13)
(O).

The one sigma uncertainty in the Target Sine Left Angle.

This field is optional. If it is sent, then the target sine left angle (AD32.4) shall also be sent.

B.1.32.14 Target Measurement Uncertainty – Target Sine Up Angle (AD32.14)
(O).

The one sigma uncertainty in the Target Sine Up Angle.

This field is optional. If it is sent, then the target sine left angle (AD32.5) shall also be sent.

B.1.32.15 Target Measurement Uncertainty – Target Velocity Ground Range
Component (AD32.15) (O).

The standard deviation of the Target Velocity Ground Range Component reported in field AD32.6, expressed in millimetres per second.

This field is Optional.

B.1.32.16 Target Measurement Uncertainty – Target Velocity Cross Range
Component (AD32.16) (O).

The standard deviation of the Target Velocity Cross Range Component reported in field AD32.7, expressed in millimetres per second.

This field is Optional.

B.1.32.17 Target Measurement Uncertainty – Target Ground Speed (AD32.17)
(O).

The standard deviation of the Target Ground Speed reported in field AD32.8, expressed in millimetres per second.

This field is Optional.

B.1.32.18 Target Measurement Uncertainty – Target Heading (AD32.18) (O).

The standard deviation of the Target Heading reported in field AD32.9, expressed in degrees.

This field is Optional.

B.2 Advanced Job Definition Extension

The Advanced Job Definition Extension (Table B-5) provides the means for the platform to pass information pertaining to the sensor job that will be performed and details of the location parameters (terrain elevation model and geoid model) used in the measurement. It includes a definition of the geographic area for sensor service, which is defined as a four-corner polygon, with the four points of the polygon chosen to define a convex quadrilateral. The Advanced Job Definition Extension shall be sent in conjunction with the parent Job Definition Segment when Advanced extensions are sent. Note that precision location of a target will not be possible until the information contained in the Advanced Job Definition Extension has been received from the transmitting platform. The Advanced Job Definition Extension supplements the Job Definition Segment described in Annex A of this document.

Table B-5. Advanced Job Definition Extension

Field	Type	Field Name		Bytes	Form	Value Range	Units
AJ1	M	Job ID		4	I32	0 to 4294967295	
AJ2	M	Radar Carrier Frequency		4	I32	0 to 4294967000, 4294967295=No Statement	kiloHertz
AJ3	M	Azimuth 3 dB Beamwidth		4	BA32	0 to +179.999979, 180.0 = No Statement	degrees
AJ4	M	Elevation 3dB Beamwidth		4	BA32	0 to +179.999979, 180.0 = No Statement	degrees
AJ5	M	Nominal Platform Position Uncertainty	X	4	I32	0 to 4294967000, 4294967295=No Statement	millimetres
AJ6	M		Y	4	I32	0 to 4294967000, 4294967295=No Statement	millimetres
AJ7	M		Z	4	I32	0 to 4294967000, 4294967295=No Statement	millimetres
AJ8	M	Nominal Platform Velocity Uncertainty	X-Prime	2	I16	0 to 65535	millimetres/sec
AJ9	M		Y- Prime	2	I16	0 to 65535	millimetres/sec
AJ10	M		Z- Prime	2	I16	0 to 65535	millimetres/sec

B.2.1 Job ID (AJ1) (M).

A platform assigned number identifying the specific request or task to which the dwell pertains.

This value must be the same as the Job ID in the Job Definition Segment in Para. 2.7 of Part 2 of Annex A to STANAG 4607.

B.2.2 Radar Carrier Frequency (AJ2) (M).

The radar's centre (carrier) frequency, reported in kiloHertz (kHz).

This field is mandatory. The No-Statement value is sent when the sensor is unable or unwilling to provide a value.

B.2.3 Azimuth 3dB Beamwidth (AJ3) (M).

The 3dB width of the main beam, in the Azimuth (Scan) direction, reported in degrees.

The No-Statement value is sent when the Azimuth 3dB Beamwidth is not provided.

B.2.4 Elevation 3dB Beamwidth (AJ4) (M).

The 3dB width of the main beam, in the elevation direction, reported in degrees.

The No-Statement value is sent when the Elevation 3dB Beamwidth is not provided.

B.2.5 Nominal Platform Position Uncertainty – X Coordinate (AJ5) (M).

Nominal estimate of the standard deviation in the platform position, measured in the X direction of the reference coordinate system defined in field AD5, expressed in millimetres.

The No-Statement value is sent when the sensor is unable or unwilling to provide a value.
(NOTE: The Nominal fields in the Advanced Job Definition Extension provide a means for reporting nominal standard deviations and uncertainty values, and are to be used when values are not received from the sensor. More precise values of these or related estimates may be reported in the appropriate fields in either the Advanced Dwell Segment Extension or the Target Report Sub-Segment, when the sensor computes them and the communication bandwidth permits the more frequent reporting.)

B.2.6 Nominal Platform Position Uncertainty – Y Coordinate (AJ6) (M).

Nominal estimate of the standard deviation in the platform position, measured in the Y direction of the reference coordinate system defined in field AD5, expressed in millimetres.

The No-Statement value is sent when the sensor is unable or unwilling to provide a value.

B.2.7 Nominal Platform Position Uncertainty – Z Coordinate (AJ7) (M).

Nominal estimate of the standard deviation in the platform position, measured in the Z direction of the reference coordinate system defined in field AD5, expressed in millimetres.

The No-Statement value is sent when the sensor is unable or unwilling to provide a value.

B.2.8 Nominal Platform Velocity Uncertainty – X-Prime (AJ8) (M).

The standard deviation of the estimate of the platform velocity in the X direction of the reference coordinate system defined in field AD5, expressed as millimetres per second.

B.2.9 Nominal Platform Velocity Uncertainty – Y-Prime (AJ9) (M).

The standard deviation of the estimate of the platform velocity in the Y direction of the reference coordinate system defined in field AD5, expressed as millimetres per second.

B.2.10 Nominal Platform Velocity Uncertainty – Z-Prime (AJ10) (M).

The standard deviation of the estimate of the platform velocity in the Z direction of the reference coordinate system defined in field AD5, expressed as millimetres per second.

B.3 Advanced Platform Location Segment

The Advanced Platform Location Extension (Table B-6) provides information pertaining to the location of the sensor platform during periods when the sensor is not collecting data. It shall be sent as required during periods in which the sensor is not collecting data, such as sensor idle times, enroute to an orbital location, or during a slewing operation. The Advanced Platform Location Extension supplements the Platform Location Segment Annex A of this document.

Table B-6. Advanced Platform Location Extension

Field	Type	Field Name		Bytes	Form	Value Range	units
AP1	M	Location Time		4	I32	0 to 4 x (10 ⁹)	milliseconds
AP2	M	Reference Coordinate System		1	E8	Per para. 4.3.2	
AP3	M	Platform Position	X	4	S64	(-2 ⁶³) to (2 ⁶³ - 1)	millimetres
AP4	M		Y	4	S64	(-2 ⁶³) to (2 ⁶³ - 1)	millimetres
AP5	M		Z	4	S64	(-2 ⁶³) to (2 ⁶³ - 1)	millimetres
AP6	M	Platform Velocity	X-Prime	4	S32	-2147483648 to 2147483647	millimetres/sec
AP7	M		Y-Prime	4	S32	-2147483648 to 2147483647	millimetres/sec
AP8	M		Z-Prime	4	S32	-2147483648 to 2147483647	millimetres/sec

B.3.1 Location Time (AP1) (M).

The elapsed time, expressed in milliseconds, from midnight at the beginning of the day specified in the Reference Time fields of the Mission Segment to the time the report is prepared.

In this manner, the Location Time corresponds to the day's UTC time converted to milliseconds, with the possible addition of multiples of 86400000 for multi-day missions.

B.3.2 Reference Coordinate System (AP2) (M).

An enumeration table that identifies the reference coordinate system for the platform.

Coordinate systems are listed in Table B-3.

B.3.3 Platform Position – X Coordinate (AP3) (M).

The coordinate of the sensor platform in the X direction of the reference coordinate system defined in field AP2, expressed in millimetres, at the Location Time provided in field AP1.

B.3.4 Platform Position – Y Coordinate (AP4) (M).

The coordinate of the sensor platform in the Y direction of the reference coordinate system defined in field AP2, expressed in millimetres, at the Location Time provided in field AP1.

B.3.5 Platform Position – Z Coordinate (AP5) (M).

The coordinate of the sensor platform in the Z direction of the reference coordinate system defined in field AP2, expressed in millimetres, at the Location Time provided in field AP1.

B.3.6 Platform Velocity – X- Prime (AP6) (M).

The velocity of the sensor in the X direction of the reference coordinate system defined in field AP2, expressed as millimetres per second, at the Location Time provided in field AP1.

B.3.7 Platform Velocity – Y- Prime (AP7) (M).

The velocity of the sensor in the Y direction of the reference coordinate system defined in field AP2, expressed as millimetres per second, at the Location Time provided in field AP1.

B.3.8 Platform Velocity – Z- Prime (AP8) (M).

The velocity of the sensor in the Z direction of the reference coordinate system defined in field AP2, expressed as millimetres per second, at the Location Time provided in field AP1.

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This Technical Memo describes the background, aims, and methodology for adding new capabilities, in the form of new extensions, to the North Atlantic Treaty Organization (NATO) Ground Moving Target Indication Format (GMTIF), known by NATO as Standardization Agreement (STANAG) 4607. These changes are required to accommodate new sensors, processing techniques, and sensor modes of operation, such as will be available from the Synthetic Aperture Radar – Ground Moving Indication (SAR-GMTI) mode onboard RADARSAT-2. Further additions are also made to provide a level of redundancy and flexibility. The RADARSAT-2 GMTI group at DRDC Ottawa was instrumental in identifying and developing these changes and having them incorporated into the GMTIF. The resulting changes, contained in Annex B, are preliminary and were needed to support data from the GMTI mode onboard RADARSAT-2. Dissemination of GMTI products is an important component of the Department of National Defence's (DND) RADARSAT-2 GMTI Technology Demonstration Project (TDP), which aims to demonstrate the utility of space-borne GMTI. RADARSAT-2 will be the first spaceborne SAR-GMTI platform to implement STANAG 4607. These advanced segment extensions will greatly enhance the dissemination capacity of GMTI data between various sensors and users. They will continue to evolve to further increase the utility and ease of use of GMTIF data to exploitation systems.

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space-borne SAR-GMTI, Interoperability, Net-centric warfare

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